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DEVELOPING BRIDGE-SCOUR EQUATIONS FOR COLORADO MOUNTAIN STREAMS

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16. Abstract

CDOT currently uses FHWA's HEC-18 methods to estimate bridge-pier scour values. Velocities, depths, and energy slopes for a bridge site are first computed in applying the FHWA methods. By applying these computed hydraulic parameters to pier-scour equations given in FHWA's HEC-18 design manual, scour values are computed for the bridge under consideration. The laboratory and field data used in developing the FHWA equations was based largely on streams with uniform sediments, subcritical-flow conditions, and flatter gradients. In western states where many bridges cross steep mountain channels, bridge-scour equations are applied beyond the range of conditions for which they were derived. Traditional equations overestimate bridge scour for hydraulic conditions encountered in steep mountain streams.

In this research study, a new bridge pier-scour equation has been developed suitable for streams flowing through mountainous regions of Colorado. This equation utilizes a dimensionless excess-velocity concept, and relates this flow parameter to pier scour. Dimensionless excess velocity, by including critical and scour-initiating velocities in its definition, accommodates the presence of cobbles and boulders through the critical-velocity term, as well as finer sand-gravel size material through the scour-initiating velocity term. The general form of the equation leads to calibration coefficients relating critical and scour-initiation velocities to representative fine material (D35 of parent-sediment material found on the river bed), and to average coarse material that exists in abundance along mountain streams.

This report presents the development of the new scour equation, and applies this equation to compute pier scour at 16 different sites scattered across mountainous parts of CDOT Regions 3 and 5. Sources of data used in the analysis are derived from 16 bridges through a culmination of bridge-scour studies conducted for CDOT by Hydrau-Tech, Inc. for a Plan of Action (POA) for Scour-Critical Bridges study. Additional coarse-material data collected for this project is described, along with methodologies employed to determine pier-scour estimates.

As shown in the report, measured and computed pier-scour values for the 38 piers included in the study show very good agreement through the entire range of observed scour values, which vary from 0 to 14 ft. Considering that the coarse material in the streams varied from 2 to 24 in, the computed velocities ranged from 2 to 15 ft/sec, and that the range of parent materials varied from sand and gravel to boulder sizes, it can be concluded that the equation was tested through a wide range of flow and environment conditions, and has been shown to be an excellent predictor.

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FINAL REPORT
DEVELOPING BRIDGE-SCOUR EQUATIONS FOR COLORADO MOUNTAIN STREAMS

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EXECUTIVE SUMMARY

CDOT currently uses FHWA's HEC-18 methods to estimate bridge-pier scour values. Velocities, depths, and energy slopes for a bridge site are computed first in applying the FHWA methods. Applying these computed hydraulic parameters to pier-scour equations given in FHWA's HEC-18 design manual, scour values are computed for the bridge under consideration. The laboratory and field data used in developing the FHWA equations was based largely on streams with uniform sediments, subcritical-flow conditions, and flatter gradients. These conditions are applicable to a large portion of streams in the eastern and southern parts of the United States. However, in western states where many bridges cross steep mountain channels, bridge-scour equations are applied beyond the range of conditions for which they were derived. Traditional equations overestimate bridge scour for hydraulic conditions that are encountered in steep mountain streams. For these cases, hydraulic engineers need customized equations suited for Colorado's geographic conditions.

In this research study, a new bridge pier-scour equation was developed suitable for streams flowing through mountainous regions of Colorado. This equation utilizes a dimensionless excess-velocity concept, and relates this flow parameter to pier scour. Dimensionless excess velocity, by including critical and scour-initiating velocities in its definition, accommodates the presence of cobbles and boulders through the critical-velocity term, as well as the finer sand-gravel size material through the scour-initiating velocity term. The development of the study's various research tasks is presented in Chapter 2. Chapter 3 presents the approach, and Chapter 4 discusses previous work conducted at Colorado State University by Dr. Molinas during a 6-year FHWA study to examine effects of gradation. Theoretical development of the new scour equation and initial steps in its derivation are presented. The general form of the equation leads to calibration coefficients relating critical and scour-initiation velocities to representative fine material (D_{35} of parent-sediment material found on the river bed), and to average coarse material that exists in abundance along mountain streams. Chapter 5 presents the new scour equation and applies this equation to compute pier scour at 16 different sites scattered across mountainous parts of CDOT Regions 3 and 5. Sources of the data used in the analysis are presented in Chapter 5. Extensive data from 16 bridges, a culmination of bridge-scour studies conducted for CDOT by Hydrau-Tech, Inc. for a Plan of Action (POA) for Scour-Critical Bridges study, is described. Additional coarse-material data collected for this project is described, along with methodologies employed to determine pier-scour estimates. Finally, tables related to scour computations are presented, and computed scour is compared with measured scour.

As shown in Figure 5.1 (page 59), measured and computed pier-scour values for the 38 piers included in the study show very good agreement through the entire range of observed-scour values, which vary from 0 to 14 ft. Considering that the coarse material in the streams varied from 2 to 24 in, the computed velocities ranged from 2 to 15 ft/sec, and the range of parent materials varied from sand and gravel to boulder sizes, it can be concluded that the equation was tested through a wide range of flow and environment conditions, and has been shown to be an excellent predictor.

IMPLEMENTATION PLAN

In this research study, a new bridge pier-scour equation suitable for streams flowing through mountainous regions of Colorado was developed. This equation utilizes a dimensionless excess-velocity concept, and relates this flow parameter to pier scour. Dimensionless excess velocity, by including critical and scour-initiating velocities in its definition, accommodates the presence of cobbles and boulders through the critical-velocity term, as well as the finer sand-gravel size material through the scour-initiating velocity term. Since excess velocity accounts for the presence of large particles found in abundance in Colorado stream beds, results of pier-scour computations using the new equation are more realistic. The use of the newly-developed equation is recommended for applications involving high-velocity mountain streams with large cobbles and boulders.

Even though the laboratory database was adequate to derive the form of the new equation, the steep-mountain scour database used in the calibration of the coefficients was limited. It is recommended that this database be expanded as new pier-scour data becomes available from mountain regions, and used in further refining the coefficients of the new equation.

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1. BACKGROUND

The CDOT presently uses FHWA's HEC-18 methods to estimate bridge-scour values in bridge-scour computations. In applying these methods, first a hydraulic computation method (FHWA's WSPRO or U.S. Army Corps of Engineers' HEC-RAS) is used to compute velocities, depths, and energy slopes for a bridge site. Applying these computed hydraulic parameters to scour equations given in FHWA's HEC-18 design manual, scour values are computed for the bridge under consideration. Depending on the strength of flows and the sediment-movement regime, clear-water and moveable-bed scour equations are used for different bed-material properties.

FHWA's HEC-18 design manual provides scour equations for clear-water and moveable-bed scour conditions. In all of these equations, hydraulic conditions are represented by the Froude number, the dimensionless ratio of velocity to depth and gravitational acceleration. In general terms, for most river flows Froude numbers are less than 0.4. For steep channels, Froude numbers are greater than 0.6, and in some cases, greater than 1 (supercritical). There is a need to develop specialized bridge-scour equations for steep mountain streams with high Froude numbers.

Using the current HEC-RAS application for steep mountain reaches, scour calculations often result in unrealistic scour depths. This is due to the fact that for steep channels, the range of Froude numbers is far beyond the data used in developing the existing equations. For mountain streams, scour is mostly related to velocity rather than the Froude number. The analysis should reflect the physical conditions with data derived from similar conditions.

2. Concept of Problem and Objectives

2.1 Problem Statement

CDOT builds and maintains many roadway projects with bridges that cross rivers and small streams. The safe and economic design of these bridges requires hydraulic computation of potential pier and abutment scour. For existing structures, potential bridge-scour computations are needed to assess the safety of these structures.

The pier- and abutment-scour equations used in the Federal Highway Administration's guidelines are presented in HEC-18 design manual. These equations were developed using hydraulic conditions of flat channels. The laboratory and field data used in developing the FHWA equations was based largely on streams with subcritical conditions and flatter gradients. These conditions may be applicable to a large portion of streams in the eastern and southern parts of the United States. However, in midwestern states where many bridges cross steep mountain channels, bridge-scour equations are applied beyond the range of conditions for which they were derived. For hydraulic conditions that are encountered in steep mountain streams in Colorado, traditional equations overestimate bridge scour. For these cases, hydraulic engineers need customized equations suited for Colorado's geographic conditions.

In the proposed approach, bridge scour for steep mountains is related to a new parameter defined as the *excess velocity*, rather than the presently-used Froude number (velocity divided by square root of gravitational acceleration times the flow depth, $F=V/\sqrt{gd}$), or shear stress (the specific weight of water multiplied by the hydraulic radius and the energy slope, $\tau = \gamma RS$), currently used in HEC-18 equations. In the present analysis, the excess velocity, representing the strength of approach flow, is related to bridge scour. Excess velocity is defined as the dimensionless velocity in excess of velocity needed to initiate the motion of bed material and initiate bridge scour.

$$\Psi = (V_a - V_i) / (V_c - V_i)$$

where Ψ = dimensionless excess velocity; V_a = approach flow velocity; V_i = velocity needed to initiate the motion of bed material; V_c = critical velocity beyond which all sizes of fractions are mobilized.

By using excess velocity, the effects of large cobbles and boulders present in steep mountain streams can be represented. Additionally, by not using a "lumped" Froude number, the exaggerated effects due to variations in depth will be eliminated.

2.2. Objectives

CDOT has stated the primary objective of this study is to provide a technical tool to compute bridge scour in steep mountain channels. The pier- and abutment-scour equations developed from the study are required to be applicable to the range of slopes, velocities, and depths encountered in bridges crossing steep Colorado streams.

In order to accomplish these objectives, enhancements to the current bridge-scour equations are needed. These enhancements can be grouped into three major categories:

- Introduction of new parameters in scour equations to represent steep mountain hydraulics (shallower depths, higher velocities, coarser bed material in the form of gravels, cobbles, and boulders);
- Calibration of new relationships with data specific to Colorado (this data is currently being collected as part of the Plan of Action for Scour Critical Bridges project); and
- Development of scour equations for mountain streams.

3. APPROACH

3.1 Research Tasks

The scope of work developed by CDOT for this project delineated six basic tasks. Each task is further delineated into sub-tasks where appropriate. This study has closely followed these tasks.

Task 1. Perform a literature review to determine if there has been similar research that will aid CDOT in improving current practices.

This task is aimed at identifying CDOT and nationwide bridge-scour and technical data for steep mountain streams. The study team has developed strong relationships with national highway agencies, including the American Association for State Highway Transportation Officials (AASHTO), the National Cooperative Highway Research Program (NCHRP), and the Federal Highway Administration, through long associations with these agencies. In conducting a literature search, these agencies were contacted and inquiries made about methodologies adopted by the agencies. The team has identified the following sources of information:

- Within Colorado: state universities, local FHWA personnel, and consulting engineering firms involved in FHWA work;
- Nationwide and internationally: other DOTs, AASHTO, FHWA, ASTM, universities and institutions; and
- The Transportation Research Board: existing and in-progress research studies available from the Transportation Research Information Services' database.

The research team studied procedures of other DOTs related to pier and abutment scour and conducted an extensive literature review. The principal author of this report, Dr. Albert Molinas, had conducted a 6-year laboratory research study for the Federal Highway Administration to identify effects of gradation and cohesion on bridge scour (1991-1996, 1998). His research resulted in the adoption of a gradation-correction factor for pier scour (the K_4 factor used in HEC-18). He also authored FHWA's BRI-STARS analysis model between 1986 and 2000 for four consecutive projects. These projects utilized various bridge-scour equations recommended by HEC-18 in addition to stream-tube computations to overcome difficulties associated with large contraction-scour estimations.

Dr. Christopher Thornton, of Colorado State University, has conducted hundreds of pressure-scour, debris-scour, and bridge-scour countermeasure experiments to examine ways to quantify and prevent adverse effects of bridge scour. As a part of this effort he conducted numerous literature reviews on bridge-scour topics. These reviews were closely related to the proposed research topic and were used by the research team.

Task 2. Conduct a national survey of state DOTs to determine if other states have had similar problems, and if so, their solutions and recommendations.

For this task, information from other state DOTs related to bridge scour was obtained. Review of the information was useful in defining governing flow parameters. In the extensive, multi-year, Colorado Statewide Plan of Action for Scour Critical Bridges (POA) project and the 2013 Emergency and Permanent Flood Recovery projects the research team collaborated with CDOT to develop needs specific to Colorado to address problems with current practices and methodologies.

Task 3. Field inspection of bridges with scour problems.

Specific bridge sites were determined by the CDOT Staff Hydraulics Engineer, Region Hydraulics Engineers, representatives of Staff Bridge, and Region Maintenance personnel. Approximately 20 candidate sites from the mountainous parts of Colorado were selected. Under the current Plan of Action (POA) for Scour Critical Bridges and Bridges with Unknown Foundations projects the research team collected hydrologic, sediment size, channel geometry, and bridge data for some mountain-bridge sites over steep channels. Hydraulic computations for velocities and depth were conducted. Existing data was supplemented by field visits to collect additional sediment data and scour information.

Figures 3.1 and 3.2 Field inspection of scour-critical bridges

Task 4. Prepare a workplan for field work and get approval for all traffic control and safety plans; inform personnel from Traffic, Maintenance, Residencies, Headquarters, and other parties involved, including outside agencies and organizations, prior to the field activities and site visits.

For this task a workplan was prepared in cooperation with CDOT headquarters staff, and the appropriate people were notified for traffic control and safety. Personnel from Maintenance, Residencies, Headquarters, and other parties involved were notified prior to field visits.

Task 5. Analyze data collected in the above tasks and develop a scour-equation design procedure to be used by CDOT hydraulics engineers statewide for calculating and analyzing scour in mountainous areas of the state.

In this task data collected from a search of existing literature, the Staff Bridge database, actual field surveys, and other unbiased, reliable sources was analyzed. For specific Colorado sites the measured scour from maintenance records and as-built drawings was correlated with various parameters including type of structures, bed materials, and hydraulic conditions. These conditions included excess velocities, depths, and geometric characteristics of piers and abutments.

Using the information collected from the previous tasks, new bridge-scour equations were developed which were specifically applicable to Colorado. In this study, the objective was to derive relationships between bridge scour and hydraulic parameters similar to those utilized in HEC-18. However, in the present approach, hydraulic parameters and relationships pertinent to steep mountain streams were developed. Using data derived from Colorado, coefficients of these relationships were calibrated to reflect local conditions. The form and applicability of the equations were discussed with hydraulic engineers from CDOT in order to customize the equations with parameters that can be reliably measured or obtained. Depending upon the availability of data, the bridge-scour equations were modified to reflect Colorado's various geographical areas, and the types of floods and the durations specific to them.

The most commonly accepted HEC-18 equation, the CSU pier-scour equation, was based on laboratory data using silt-sized sediments where the initiation of motion occurred at very low velocities. As a result, scour predictions based on this equation are overly conservative. In steep mountain streams the river beds are composed of large gravel, cobbles, and boulders. Initiation of scour does not occur until stream velocities reach significantly higher levels. By using the concept of excess velocity, the approach outlined in this report overcomes this deficiency of high scour-initiating velocities. The excess-velocity concept also considers the critical velocity of sediment mixtures to account for the presence of coarse fractions in river beds.

Shear stress is defined as the specific weight of water multiplied by the hydraulic radius and energy slope. The energy slope may vary by several orders of magnitude depending on the reach length and accuracy of assumed downstream elevations. Velocity is easier to compute and verify in the field, and there are less variations which are due to limited computational accuracy.

The Froude number is the ratio of velocity to the square root of gravitational acceleration times the flow depth, $F = V/\sqrt{(gd)}$. Steep mountain channels are characterized by shallower depths, and the range of depth variation is limited. As a result, scour is not related to square root of depth, but more closely to $d^{1/6}$. Therefore equations based on Froude numbers overestimate the effects of depth.

Excess velocity accounts for the presence of large material. Computed-scour depths using excess velocity equations would be zero rather than an unreasonably large value for velocities less than or slightly greater than the velocity needed to move the bed material.

In the past, experiments at CSU which studied the effects of gradation on bridge scour (Molinas, 1998) have shown that when the correlations between measured bridge scour and flow strength were conducted with effective velocity instead of the traditional Froude number, the scour overestimation was reduced, even when using FHWA's recommended equations.

By not using the “lumped” Froude number, the exaggerated effects of variations in depth will be eliminated. This process is commonly used in sediment-transport relationships where sediment transport is related to velocity rather than Froude number.

Sediment-transport literature and FHWA publications provide various definitions of critical velocity, and define this term for various sediment sizes. Dr. Molinas’ research study for FHWA has provided a more-definitive relationship for critical velocity for graded sediments which are commonly encountered in mountain streams, and which are the reason for channel-bed armoring. The validity of various definitions was tested with field data by comparing computed critical velocities corresponding to surface/subsurface bed material with actually-experienced velocities during known historical flooding events.

Task 6. Submit draft and final reports which properly address comments of the study panel.

A draft final report for the research study was prepared, which included observations, findings, and recommendations. This document is the final report.

4. Previous CSU Studies on the Effects of Gradation and Coarse-Material Fraction on Pier Scour

4.1. General

Pier scour has been extensively studied in the past for uniform and graded-sediment mixtures. In general, pier-scour equations account for the variation in sediment properties either by including a correction factor for sediment gradation, or by the use of median size and a gradation coefficient in developing experimental regression equations. This study focused on a new governing sediment parameter which describes the characteristics of the coarse fraction available in mixtures. It also accounts for the wide variation in scour depth for mixtures with the same median size and size-gradation factor. Along with a dimensionless flow-intensity parameter, a pier-scour equation was developed to account for sediment properties in the clear-water scour range. This equation was shown to be applicable to sediment sizes ranging from 0.1 mm to 40 mm. In this study pier-scour experiments were conducted with non-cohesive materials to identify the effects of sediment properties on the resulting scour. For this purpose ten sets of experiments were performed, which were designed to vary sediment size, gradation, and other size-distribution properties. Pier-scour experiments for each sediment mixture were conducted by varying approach-flow conditions. Since the primary goal of the study was to define effects of gradation and coarse-material fraction on pier scour, other flow variables such as depth, flow angle of attack, pier shape, etc., were kept constant.

4.2. Experimental Setup and Measurements

This section describes experimental flumes, sediment mixtures used as bed materials, piers, experimental procedures, and individual measurements employed in quantifying effects of gradation and coarse-material fraction on pier scour.

4.2.1. Laboratory Flumes

Three laboratory flumes, designated as hydrodynamics flume, sedimentation flume, and river mechanics flume, were utilized simultaneously for conducting pier-scour experiments in non-cohesive sediment mixtures. The first two flumes were sediment-recirculating facilities, while the latter did not recirculate sediment. All flumes are housed at the Hydraulics Laboratory of the Engineering Research Center at Colorado State University. The water supply to these flumes is from the nearby Horsetooth Reservoir. The temperature of the water in the laboratory is controlled through a system of heated pipes.

Hydrodynamics Flume

The hydrodynamics flume is a tilting, water-and-sediment recirculating, laboratory facility. The flume is 0.6 m wide, 0.75 m deep, and 18 m long, and is made of a steel bottom with plexiglass side walls to allow visual observations. The facility is rigidly supported on U-shaped steel frames spaced every 1.2 m, and is equipped with angled upper- and lower-flange stiffeners. The bottom flanges are supported on two I-beams spanning the full length of the flume, and ground supported at the far upstream, middle, and far downstream. Two carefully-leveled guide rails are mounted on the top flanges to provide an escorting track for the measuring carriage. The flume can be tilted around its central longitudinal axis by the synchronized operation of two mechanical jacks located at the upstream and downstream ends.

Flow is supplied to the flume from a ground sump via a 0.3-m diameter steel pipe, equipped with a 0.15-m diameter bypass for fine tuning of the flow, and a 20-HP centrifugal pump. The flow is first introduced to an upstream head box, equipped with a multi-layer screen containing gravel at its outlet to serve as a flow guide to provide uniform velocities and turbulence characteristics at the entrance of the flume. A wave suppressor is then introduced. The flow depth is controlled by a downstream rotating gate hinged across the bottom of the flume, spanning the full width, and operated by a system of pulleys. Because of the tail-gate control and the nature of the flume, a back water effect was sometimes noticed, causing the water depth to increase as the gate was approached.

A uniform sediment layer 23 cm thick was prepared from the tested mixture and spread along the full length of the flume. Provisions were made for a downstream 1.8 m-long sediment trap and an upstream 1.8 m-long transition zone. The upstream transition zone is composed of coarser sediments, with a sloping profile carefully designed to provide excess friction to ensure fully-developed turbulent flow, with a boundary layer hitting the free surface far upstream of the study reaches for all flow conditions.

Sedimentation Flume

The sedimentation flume is an elevated sediment-transport testing facility that provides both longitudinal tilting and sediment recirculation. The flume is 60 m long, 2.4 m wide, 1.2 m deep, and allows for slope adjustments up to 3 percent through a system of hydraulic jacks. The flume is constructed from steel plates at the bottom and sides, with plexiglass windows along specific locations at its side. The structure's skeleton is composed of U-shaped lateral steel frames supported on box-sectioned longitudinal girders. A walkway is cantilevered from the lateral frames on each side of the structure. The upper flanges house guide rails for an electrically-motorized measuring carriage that can move to any point in the flume.

Three different pumps (125, 150, and 250 HP), with a maximum combined-flow capacity of 3 m^3/s, can be simultaneously operated to supply water to the flume from a reservoir sump via three separate steel pipelines. The flow is first introduced to the upstream head box, which contains several guide vanes and flow straighteners followed by a honeycomb mesh. It then passes through a gravel-filled screen followed by a wave suppressor. Rapid development of the fully-turbulent boundary layer is achieved by an upstream concrete ramp and/or artificial roughening of the entrance zone. The flow depth is regulated through a manually-operated, downstream, adjustable tail gate.

The sediment bed is built to a thickness of approximately 0.4 m, with provisions made for a downstream sediment trap that extends for 6 m. To facilitate drainage of the flume after the experiments, a perforated 10 cm-diameter PVC pipe was embedded in the bed material and spanned the full length of the study reach. A motorized instrument carriage runs longitudinally on rails mounted on the side walls of the flume.

River Mechanics Flume

The river mechanics flume is a fixed-slope facility. The flume is 6 m wide, 0.9 m deep, and approximately 30 m long. The test section, however, was 24 m long, 5.1 m wide, and 0.9 m deep, equipped with two plexiglass viewing sections along one side of the flume, and a large upstream reservoir to create uniform entrance conditions. I-beam rails are mounted on the side walls to provide a track for the measuring carriage.

A 75-HP axial pump with maximum capacity of approximately 0.6 m^3/s supplies water to the flume through a 0.6 m-diameter pipeline. The upstream main ends in a similar-size diffuser located orthogonal to the main flow direction, to distribute the flow uniformly across the flume width. The flow then passes through a gravel-filled screen, followed by an artificially-coarsened concrete ramp that joins the main sediment bed. The setup also includes a downstream sediment trap, and a downstream sill for depth regulation.

4.2.2. Piers

For the pier-scour experiments conducted in the sedimentation flume, three identical 1.22 m-high, clear plexiglass, cylindrical piers with an outside diameter of 0.18 m were utilized. Circular piers were used because of their symmetry and the abundance of data available for comparative purposes. The three piers were placed at the center line of the flume for each run. In the longitudinal direction, the leading pier was 13.7 m from the head box of the flume, the second was 24.4 m from the head of the flume, and the third was 36.6 m from the head of the flume. To keep side-wall effects insignificant, the maximum pier size (for use in the 2.48 m wide flume) was kept at 0.18 m, that is, with a flume-width-to-pier-width ratio of 13.7:1.

Depth measurements for pier scour with time were achieved utilizing visual techniques. For this purpose, the piers were constructed of transparent plexiglass material, and a measuring scale was glued to the front, side, and back of each pier. In addition, a mirror with the handle angled at 45° was placed at the base of the pier. At any time the base and deepest point of the scour hole could be easily identified and recorded by sliding the mirror within the plexiglass pier and reading the corresponding measurement on the scale. In this way scour depth with elapsed time could be obtained up to an accuracy of ± 1.5 mm. A bright light located above the water surface was used to improve the visibility of the scour region under clear-water scour conditions.

For the hydrodynamics-flume experiments, three plexiglass piers with outside diameters of 0.051 m, 0.051 m, and 0.07 m were installed in the flume, equidistant from the walls.

Pier-scour experiments in the river mechanics flume investigated the effects of pier width on the resulting scour. For this purpose six additional pier diameters, 0.019 m, 0.032 m, 0.057 m, 0.089 m, 0.165 m, and 0.216 m, were tested.

4.2.3. Sediment Mixtures

Previous researchers have indicated that there is a very strong tendency for alluvial sediments to follow the log-normal size distribution. This size distribution can be represented by a straight line on plots using logarithmic-normal probability scales. In this case the median sediment size, D_{50}, is also the geometric mean diameter, D_g, of the sediment mixture, where D_{50} is the sediment diameter for which 50 percent of the sediment material is finer by weight. The geometric standard deviation, σ_g, is given by:

$$\sigma_g = \frac{D_{84}}{D_{50}} = \frac{D_{50}}{D_{16}} \tag{1}$$

or,

$$\sigma_g = \frac{1}{2}\left(\frac{D_{84}}{D_{50}} + \frac{D_{50}}{D_{16}}\right) \tag{2}$$

or,

$$\sigma_g = \sqrt{\frac{D_{84}}{D_{16}}} \tag{3}$$

where: D_{16}, D_{50}, and D_{84} are the sediment diameters for which 16, 50, and 84 percent of the sediment material is finer by weight, respectively.

The log-normal distribution function is a two-parameter distribution and is completely defined by D_{50} and σ_g. However, most natural sediments show an approximate log-normal distribution only through the mid part of the distribution, approximately $D_{50} \pm \sigma_g$, but they usually have long tails in both the coarse and fine fractions. Thus, equations 1-3 are for gradation coefficients that measure the spread of the distribution only between D_{84} and D_{16} in most natural sediments. The presence of coarse material in sediment mixtures is better defined by sizes of different quantities, such as D_{98}, D_{95}, D_{90}, etc. For the work here, D_{50} and σ_g were held constant and sizes of D_{90}, D_{95}, D_{98}, etc., were changed, since armoring in the scour hole involves mostly the coarser fractions of the mixture.

There is a specific requirement that must be met in determining the gradation of the initial grain-size distribution for the sediment mixtures. The median-size diameter must be kept constant throughout the study. In the sedimentation-flume sand-scour experiments, the median diameter was chosen to be 0.75 mm, with gradation coefficients varying between 1.3 and 4.0. In the hydrodynamics-flume sand-scour experiments, the median diameter was chosen to be 1.8 mm, with gradation coefficients varying between 1.1 and 4. Additional runs using 0.75-mm uniform sand were conducted to study scaling effects. In the river-mechanics flume sand-scour experiments, 0.45-mm sand with a gradation coefficient of 2.3 was used. Finally, in the gravel-scour experiments conducted in the sedimentation flume the median diameter was chosen to be 18 mm, with gradation coefficients varying between 1.4 and 2.3.

The properties of the sediment mixtures used in the pier-scour experiments are given in Table 1.

4.2.4. Measurements

A series of measurements is needed to define the relationship between local pier scour and the various hydraulic, geometric, and sediment parameters. These measurements are presented below.

Flow Discharge

The water discharge in all three test flumes was measured through a system of an orifice-meter and a differential manometer. For the hydrodynamics flume, two orifice plates were available: one mounted on the 0.3 m-diameter main, and the other attached to the 0.15 m-diameter bypass line. Both orifice plates were connected to a dual water-mercury manometer for detecting the pressure drop across the ends of the plate. The flow discharge was then computed from the calibration curves for the orifices. The pressure tapping across the orifice plate was connected to the manometer through hard vinyl tubing, provided with bleeding valves for drainage and for ensuring an air-free environment. The sedimentation flume is equipped with three similar setups for measuring the discharge, each attached to a different pump. Extreme care was taken to ensure the release of air bubbles entrapped in all manometer lines. Flow discharges were also estimated by integrating the vertical-velocity profiles over the entire cross section of the flume at several locations. The error in measuring the discharge in the hydrodynamics flume is approximately 3 percent, in the sedimentation flume approximately 4 percent, and in the river mechanics flume approximately 5 percent. These estimated errors are due to the calibration errors of orifice plates, unsteadiness in the pump discharge, and fluctuations in manometer readings.

Flow Velocity

In the hydrodynamics flume, velocities were measured utilizing a two-dimensional, electromagnetic, Marsh McBirney Model 523 velocity meter attached to a point gauge. This was used to measure velocity components in two orthogonal directions in the plane parallel to the bottom of the flume. The meter consisted of a spherical, electromagnetic probe with cable and signal processor powered by 6-V DC, externally charged with 110-V AC. The probe has a diameter of 12 mm and is mounted on a 6 mm-diameter, vertical standing rod. The analog signals corresponding to the two orthogonal velocities sensed by the probe were intercepted by a multi-channel data-acquisition board connected to a personal computer. The sampling duration was 30 s, with a frequency of 50 Hz. This setup resulted in velocity measurements accurate to within approximately ± 3.5 percent.

In the river-mechanics and sedimentation flumes, velocities were measured with a one-dimensional Marsh McBirney Model 2000 electromagnetic flow meter with a 2.54-cm elliptic probe and a digital-display conversion voltmeter. The error in accuracy of the flow meter is reported to be ± 2 percent by the manufacturer, and its operating range is from -0.015 m/s to +6.1 m/s within temperature extremes of 0°C to 71°C. The overall error in accuracy of the velocity-measuring setup is estimated to be ± 5 percent.

Flow Depth and Hydraulic Grade Line

In the case of non-uniform material, bed irregularities affect the accuracy of bed-elevation measurements. Theoretically, during experiments the bed surface is not known and the bed elevation measurement at any section depends on the position of the tip of the point gauge relative to the larger grains on the bed. To reduce such errors, during the sedimentation-flume experiments three different point-gauge readings utilizing a flat tip were taken across each of the test sections. The bed elevation was assumed as the average of these three values. Using a point-gauge tip, the corresponding water-surface elevations were also measured. At specified test sections the depth of flow was then calculated as the average difference between the water-surface and the bed-surface elevations. For all experimental runs a uniform flow depth over the entire flume length was maintained at 0.3 m ± 0.03 m by regulating the tail gate at the flume exit. However, the local flow depth varied along the flume length during run numbers MA-12, MA-19, and MA-27 in response to the presence of bed features.

Slope in laboratory flumes is one of the most difficult quantities to measure. Care was taken to reduce the error in slope measurements as much as possible. For this reason bed levels were measured using the point gauge, then corrected through conversion factors obtained from a careful leveling of the carriage along the entire flume using a surveyor's level and rod. The bed slope was then computed as the slope of the line of best fit based on least-square criteria. The slope of the water surface was calculated in a similar manner.

In the hydrodynamics flume the water-surface elevations were measured using point gauges with a resolution of ± 0.3 mm. Water-surface elevation measurements were conducted at a minimum of three approach cross sections per pier, and at a minimum of four locations across the flume width at each cross section. At every location in the cross section, the water level was considered to be the average of detected values to account for any residual fluctuations in the supply discharge, and any surface waves induced by the setup. This tedious procedure assumed an accuracy of ± 2 percent in the computed water depth. The hydraulic grade line is identified through regressing the measured water-surface values after being adjusted with the level-correction factors. The regression resulted in high correlation coefficients (R^2 = 0.95). The velocity head was then added to the hydraulic grade line to define the total energy line.

Free-Stream-Bed and Scour-Hole Topographies

The bed topographies for the scour holes and the free-stream approaches were measured using point gauges. In all flumes, the standard procedure for measuring topography started with leveling the instrumentation carriages at each measurement location along and across the flume to account for the potential unevenness of tracks. Choosing an arbitrary fixed level, every location in the flume, as identified by its Cartesian coordinates, was assigned a correction factor reflecting its elevation relative to the fixed level. In the hydrodynamics flume, point gauges with flat, pointed tips were utilized for measuring purposes, depending on the location and accuracy desired. The bed topographies at four different approach sections were measured for each pier model to define the upstream bed elevation. At each cross section the bed level was considered to be the average of ten measurements evenly distributed across the flume's width. To define bed topography in the vicinity of local scour requires more intensive measurements. An intensive measuring grid was adopted to describe the scour-hole region for each pier. A similar procedure was followed for the other two flumes, with provisions made for measuring the initial as well as the final levels.

The raw measurements were adjusted with leveling correction factors for each location and then regressed together to yield the value of the bed slope. Approximately 300 topography measurements were performed for each pier model per experiment. Due to the large sampling size, the error in bed measurements is considered to be equal to ± 1/4 of the D_{90} grain size. The maximum scour-depth value for each run was calculated as the difference between the mean initial bed elevation and the lowest measured point of scour around each pier.

Scour Versus Time Measurements

The measurement of the scour-hole development for piers utilized visual techniques. As mentioned above, piers were made from transparent plexiglass. Measuring-grid tapes were affixed to the interior wall at the front, side, and back of each pier. Using a simple periscope with an inclined mirror, the development of scour with time was recorded without interfering with the flow. A series of lights was used to facilitate the observation of the scour-hole development. The depth of scour was recorded at regular intervals as the scour hole formed. The frequency of scour-depth measurements decreased as the rate of scouring decreased. The experiments were stopped when no change occurred to the maximum depth of the scour hole over a period of 4 hours.

Sampling of the Armor Layer

At the end of each experiment, the particle-size distribution of the armor layers formed around each pier in the scour hole, approach bed to each pier and downstream of the pier, were measured from samples obtained by the "flour-paste technique" described by Ahmed (1989). Sieve analysis was then performed on the samples using U.S. standard sieves and the available shaker in the Sediment Laboratory of the Engineering Research Center, at Colorado State University.

To determine the grain-size distribution of the armor layer, it was necessary to collect all grains from only the top layer. The most common method used by previous researchers for this purpose is the "wax method." Gessler (1967) used molten resin at 200°C, Little and Mayer (1972) used purified beeswax at 65°C to 68°C, Davies (1974) used molten petroleum wax at 76°C to 78°C, and Proffitt (1980) used paraffin wax at 55°C to 57°C. In previous work, the measured grain-size distribution of the armor layers was found to be highly affected by the temperature of the wax poured onto the bed. If the temperature is outside the narrow ranges specified above, the wax either permeates down before solidifying, or solidifies before all grains in the top layer adhere to it.

Day (1976) used the "paint method" to identify grains in the top layer, but still used the wax method to lift it up. This method predicted a coarser grain-size distribution of the armor layer than the wax method. Day explained this to be caused by the penetration of the wax below the armor layer.

In the present study, the flour-paste technique was used. The procedure proved to be much easier than the wax method in terms of preparation, use, elapsed time, and separation of the grains adhering to the paste. The paste was sticky enough for all grain sizes to easily adhere in a thick layer so that the paste did not penetrate further than the surface layer.

After the bed was allowed to dry, the paste was placed on the surface of the bed. A gentle uniform pressure was applied downward on the paste to pick up all the grain sizes on the surface layer. The paste was then lifted up, bringing with it the grains that had been the surface layer. The process of separating the grains from the paste was achieved simply by washing the surface of the paste with warm water, and gently brushing by hand. A visual observation of the resulting surface of the paste clearly indicated that all grains, even the finest, were separated from the paste. The material was then dried, weighed, sieved, and the grain-size distribution of the armor layer at a specific area for a given flow condition was obtained.

Grain-Size Distribution

Mechanical (or sieve) analysis was used to determine the particle sizes and their relative distribution for particles greater than 0.074 mm (0.0029 in.). The smallest sieve size used in this analyses was the U.S. No. 200. The sieve number corresponds to the number of openings per linear inch. For example, the U.S. Bureau of Standards No. 8 sieve has eight openings per inch.

To accomplish the mechanical analysis, sieves were stacked one on top of the other in a nest of sieves, in which the largest screen opening (smallest sieve number) was on top, progressing to the sieve with the smallest screen openings (largest sieve number) on the bottom of the nest. A lid was placed on top of the nest and a pan was placed below the bottom sieve to catch any sediment that passed through the smallest opening. A 10-min shaking period was used in this procedure. A larger sample would require a longer shaking period. Similarly, a sample composed primarily of fine-grained material would require a longer shaking period than a coarser-grained sample of equal weight.

4.2.5. Experimental Procedure

Preparation for the scour test was initiated by leveling the bed. Prior to each run, the sediment bed was leveled with the aid of a flat plate of the same width as the flume, which was connected vertically to the instrument carriage by clamps. By employing a point gauge mounted on the carriage, initial-bed elevations were taken to check the leveling of the flume and calculate the average initial-bed elevation around each pier.

The gate was kept closed until the flume was filled with water. Then the gate was adjusted to get the desired depth, and the valves of the pump were adjusted to get the desired discharge, which was determined with an orifice inserted in the recirculating pipeline. Flow depth in the sedimentation flume experiments was maintained at approximately 0.3 m, and water-surface and bed slopes were almost parallel. For the hydrodynamics flume experiments, flow depth was kept at approximately 0.08 m.

Once the desired flow conditions were verified, the carriage and point gauge were moved along the flume in such a way that any point in the study area could be reached with the measuring devices. The water-surface profile was measured along the length of the flume to calculate its slope. Vertical-velocity profiles and development of scour with time were recorded during each experiment. In the sedimentation-flume experiments, a 16-hour duration was selected to allow maximum scour to be reached and the final scour-hole geometry to be established. This period was long enough to maintain a constant maximum-scour depth for at least 3 to 4 h. The hydrodynamics-flume experiments used longer test durations. Test runs up to 56 h showed that, for the ranges of sediment sizes and gradation used in the experiments, the longer experiment durations did not alter maximum scour. For a given discharge, once the surface-armor layer was formed, bed profiles remained virtually constant. At the end of each run, the tail gate was slowly closed and the pump stopped to drain the flume without any disturbance. Then the flume was slowly drained with the aid of an efficient drainage system on the floor of the flume, with its end open toward the tail gate.

The bed was then allowed to dry over a 24-h period, photos of scour holes around each pier were taken, and measurements of the final bed elevations were recorded to determine the maximum-scour depth around each pier and the final bed slope. The bed was allowed to dry another 24 h, and then the armored layers around each pier and different areas in the approach and downstream of the piers were sampled using the flour-paste technique. Sieve analysis was then performed on the samples using U.S. standard sieves. The sieving of the sediment samples was completed by using a series of sieves sized at intervals of $\sqrt{2}$ times the sieve diameters.

This procedure was repeated for each run. In the sedimentation-flume experiments, the area around each pier within 6.1 m had to be refilled with the proper mixtures, leveled and saturated with water. Flow conditions were verified, and velocity was measured at the approach of each pier, in addition to the water-surface profile measurements and scour depth with time. After the scour depth became constant with time for at least 3 to 4 h the flow was stopped to let the bed dry, and final bed elevations were taken. Finally, the surface layers around each pier as well as the approach and downstream of each pier were sampled to determine the size distribution of the armored layers.

4.3 Experimental Results

A comprehensive experimental program was designed to investigate the different aspects of gradation and coarse-material-fraction effects on local pier scour. These experiments were categorized into ten sets of runs, labeled 1-10. The experimental program was carried out concurrently in three different laboratory facilities. Sets 1-3, 9, and 10 were conducted in the sedimentation flume; sets 4-7 were performed in the hydrodynamics flume; and set 8 experiments were carried out in the mechanics flume. Thirteen different sediment mixtures, and 10 different pier models were subjected to a range of flow conditions, resulting in a total of 188 different pier-scour case studies.

Set 1 experiments were conducted by subjecting three identical piers to specified flow conditions. The purpose was to check the repeatability of results for scour depth at the three piers which were subjected to the same flow conditions. The first set (runs MA-1 through MA-12) was performed using a graded-sand mixture with a geometric standard deviation, σ_g, of 2.43, and D_{50} of 0.75 mm.

Set 2 experiments (runs MA-13 through MA-19) were conducted using the same sand with σ_g of 2.43 and D_{50} of 0.75 mm as the bed material around pier 1. Around piers 2 and 3 the size of coarse-material fraction in the original sediment mixtures, 10 percent around pier 2, and 5 percent around pier 3, was increased. The gradation coefficient, σ_g, and D_{50} were kept constant at 2.43 and 0.75 mm, respectively. The purpose of this second set of experiments was to examine the behavior of the scour depth with the increase in sizes of sediments for the fraction above D_{90} and D_{95} in the original sediment mixture, without changing the gradation coefficient.

Set 3 experiments (runs MA-20 through MA-27) used a sediment mixture with σ_g of 3.4 and D_{50} of 0.75 mm as the bed material around pier 2, and increased the coarse fraction above D_{90} in the same sediment mixture as the bed material around pier 1. For pier 3, a uniform sand with σ_g of 1.38 and D_{50} of 0.75 mm were used. The purpose of set 2 and 3 experiments was to investigate the effect of increasing the coarse-material fraction and gradation of bed materials on local pier-scour depth.

Sets 4-7 were conducted in a smaller flume with scaled down (1:4) flume width, flow depth, and pier width. In sets 4-6, a coarse sand mixture with the same median diameter, D_{50}, of 1.8 mm, but different gradation coefficients, was subjected to a range of approach-flow conditions. In set 4, a uniform mixture with σ_g of 1.15 was used. In sets 5 and 6, σ_g were 2.43 and 3.4, respectively. Finally, in set 7 the same sediment used in set 1 (with D_{50} of 0.75 mm and σ_g of 2.43) was used to study scaling effects.

Set 8 experiments were conducted in the 5.18 m-wide river mechanics flume to examine and verify effects of pier sizes. For this purpose, a series of circular piers with various diameters was subjected to the same oncoming flow. The sediment used for these experiments was medium sand with a median diameter of 0.55 mm and gradation coefficient of 2.43. The results of these experiments were used to establish scaling parameters for pier widths. In general, it was found that pier scour is a function of $b^{2/3}$.

Sets 9 and 10 were conducted in the sedimentation flume, and examined the effects of coarse fraction on gravel scour. The two sediment mixtures used in these experiments both had a median diameter of 18 mm and gradation coefficient of 1.45. However, the gravel mixture used in set 9 experiments contained larger coarse fractions. The D_{90} for the mixtures used in sets 9 and 10 was 40 mm and 22 mm, respectively. The purpose of these experiments was to investigate the range of applicability of the theory developed from the study.

A summary of the sediment characteristics associated with the different mixtures utilized in the study is given in Table 1. Tables 2-7 present the cases. In the pier-scour experiments presented in this section, the effects of the following parameters were investigated:

- Effect of mean sediment size, D_{50} (all sets);
- Effect of sediment gradation, σ_g (all sets);
- Effect of the coarsest 10th percentile of the sediment-size gradation (sets 1-3 and 9-10);
- Effect of flow depth, Y (all sets); and
- Effect of pier diameter, b (set 8).

The following sections present results of experiments. References to related summary tables are given whenever applicable.

Table 1. Properties of Sediment Mixtures Used in Pier-Scour Experiments

Mixture No. (1)	Mixture ID (2)	σ_g (3)	D_m (mm) (4)	D_{16} (mm) (5)	D_{35} (mm) (6)	D_{50} (mm) (7)	D_{65} (mm) (8)	$D_{84.6}$ (mm) (9)	D_{85} (mm) (10)	D_{90} (mm) (11)	D_{95} (mm) (12)	D_{99} (mm) (13)	D_{cfm} (mm) (14)	D_{cfm}/D_{50} (15)
1	MA-1A	2.43	0.75	0.31	0.50	0.75	1.11	1.83	1.83	2.10	2.36	4.80	2.59	3.46
2	MA-1B	2.43	0.75	0.31	0.50	0.75	1.11	1.83	1.83	2.80	5.00	8.00	4.24	5.65
3	MA-1C	2.43	0.75	0.31	0.50	0.75	1.11	1.83	1.83	2.00	2.36	8.00	3.09	4.12
4	MA-2E	3.40	0.75	0.23	0.45	0.75	1.31	2.65	2.65	4.76	6.40	8.00	5.50	7.33
5	MA-2D	3.40	0.75	0.23	0.45	0.75	1.31	2.65	2.65	3.20	4.20	8.00	4.24	5.66
6	MA-3	1.38	0.75	0.55	0.65	0.75	0.87	1.05	1.05	1.18	1.22	1.30	1.19	1.59
7	HN-1	3.70	1.87	0.40	1.02	1.87	3.00	5.47	5.47	6.30	8.04	10.00	7.36	3.93
8	HN-2	1.15	1.87	1.56	1.74	1.87	2.01	2.21	2.21	2.26	2.32	2.38	2.29	1.23
9	HN-3	2.17	1.80	1.10	1.29	1.80	2.53	3.89	3.89	4.39	4.93	5.60	4.69	2.61
10	HN-4	1.28	0.76	0.63	0.66	0.76	0.87	1.03	1.03	1.08	1.14	1.19	1.11	1.46
11	MH-1	2.24	0.55	0.22	0.40	0.55	0.75	1.10	1.10	1.30	1.60	2.30	1.53	3.40
12	MH-2	1.28	16.90	11.50	16.10	16.90	17.84	19.10	38.10	40.00	42.40	45.00	41.30	2.44
13	MH-3	1.30	16.70	13.00	15.20	16.70	18.16	20.20	20.20	20.90	21.70	22.40	21.30	1.28

Table 2. Summary of Sand-Scour Experiments in Sedimentation Flume for Set 1 (runs 1-12)

Run ID	Mixture ID	Median Diameter D_{50} (mm)	Gradation Coefficient σ_g	Flow Discharge Q (l/s)	Approach Depth Y (m)	Approach Velocity V (m/s)	Energy Slope S_e	Froude Number Fr	Scour Depth D_s (m)	Flow Duration t (h)
MA-1-1	MA-1	0.75	2.43	206.43	0.384	0.213	0.00020	0.11	0.037	8
MA-1-2	MA-1	0.75	2.43	206.43	0.396	0.204	0.00020	0.10	0.037	8
MA-1-3	MA-1	0.75	2.43	206.43	0.399	0.201	0.00020	0.10	0.034	8
MA-2-1	MA-1	0.75	2.43	246.07	0.287	0.347	0.00040	0.21	0.076	8
MA-2-2	MA-1	0.75	2.43	246.07	0.293	0.341	0.00040	0.20	0.067	8
MA-2-3	MA-1	0.75	2.43	246.07	0.293	0.338	0.00040	0.20	0.067	8
MA-3-1	MA-1	0.75	2.43	300.16	0.287	0.421	0.00060	0.25	0.168	19
MA-3-2	MA-1	0.75	2.43	300.16	0.290	0.405	0.00060	0.24	0.143	19
MA-3-3	MA-1	0.75	2.43	300.16	0.293	0.405	0.00060	0.24	0.143	19
MA-4-1	MA-1	0.75	2.43	300.16	0.381	0.302	0.00040	0.16	0.049	12
MA-4-2	MA-1	0.75	2.43	300.16	0.375	0.302	0.00040	0.16	0.049	12
MA-4-3	MA-1	0.75	2.43	300.16	0.378	0.290	0.00040	0.15	0.046	12
MA-5-1	MA-1	0.75	2.43	263.63	0.354	0.296	0.00042	0.16	0.046	8
MA-5-2	MA-1	0.75	2.43	263.63	0.344	0.293	0.00042	0.16	0.046	8
MA-5-3	MA-1	0.75	2.43	263.63	0.341	0.296	0.00042	0.16	0.040	8
MA-6-1	MA-1	0.75	2.43	280.34	0.335	0.332	0.00045	0.18	0.088	12
MA-6-2	MA-1	0.75	2.43	280.34	0.335	0.332	0.00045	0.18	0.082	12
MA-6-3	MA-1	0.75	2.43	280.34	0.335	0.329	0.00045	0.18	0.079	12
MA-7-1	MA-1	0.75	2.43	323.10	0.323	0.396	0.00060	0.22	0.146	16
MA-7-2	MA-1	0.75	2.43	323.10	0.326	0.390	0.00060	0.22	0.134	16
MA-7-3	MA-1	0.75	2.43	323.10	0.326	0.387	0.00060	0.22	0.134	16
MA-8-1	MA-1	0.75	2.43	360.76	0.320	0.442	0.00065	0.25	0.186	12
MA-8-2	MA-1	0.75	2.43	360.76	0.326	0.411	0.00065	0.23	0.183	12
MA-8-3	MA-1	0.75	2.43	360.76	0.323	0.421	0.00065	0.24	0.183	12
MA-9-1	MA-1	0.75	2.43	267.03	0.320	0.335	0.00043	0.19	0.091	16
MA-9-2	MA-1	0.75	2.43	267.03	0.311	0.335	0.00043	0.19	0.079	16
MA-9-3	MA-1	0.75	2.43	267.03	0.305	0.341	0.00043	0.20	0.079	16
MA-10-1	MA-1	0.75	2.43	390.49	0.332	0.469	0.00070	0.26	0.195	10
MA-10-2	MA-1	0.75	2.43	390.49	0.326	0.457	0.00070	0.26	0.186	10
MA-10-3	MA-1	0.75	2.43	390.49	0.317	0.460	0.00070	0.26	0.183	10
MA-11-1	MA-1	0.75	2.43	429.00	0.335	0.491	0.00073	0.27	0.207	14
MA-11-2	MA-1	0.75	2.43	429.00	0.329	0.479	0.00073	0.27	0.198	14
MA-11-3	MA-1	0.75	2.43	429.00	0.320	0.494	0.00073	0.28	0.207	14
MA-12-1	MA-1	0.75	2.43	473.74	0.363	0.503	0.00085	0.27	0.198	16
MA-12-2	MA-1	0.75	2.43	473.74	0.363	0.524	0.00085	0.28	0.195	16
MA-12-3	MA-1	0.75	2.43	473.74	0.384	0.482	0.00085	0.25	0.201	16

Table 3. Summary of Sand-Scour Experiments in Sedimentation Flume for Set 2 (runs 13-19)

Run ID	Mixture ID	Median Diameter D_{50} (mm)	Gradation Coefficient σ_g	Flow Discharge Q (l/s)	Approach Depth Y (m)	Approach Velocity V (m/s)	Energy Slope S_e	Froude Number Fr	Scour Depth D_s (m)	Flow Duration t (h)
MA- 13-1	MA-1A	0.75	2.43	314.32	0.323	0.390	0.00055	0.22	0.155	16
MA- 13-2	MA-1B	0.75	2.43	314.32	0.323	0.366	0.00055	0.19	0.049	16
MA- 13-3	MA-1C	0.75	2.43	314.32	0.323	0.372	0.00055	0.21	0.067	16
MA- 14-1	MA-1A	0.75	2.43	206.43	0.311	0.256	0.00029	0.15	0.049	16
MA- 14-2	MA-1B	0.75	2.43	206.43	0.314	0.250	0.00029	0.14	0.012	16
MA- 14-3	MA-1C	0.75	2.43	206.43	0.314	0.250	0.00029	0.14	0.027	16
MA- 15-1	MA-1A	0.75	2.43	146.11	0.305	0.250	0.00022	0.11	0.009	16
MA- 15-2	MA-1B	0.75	2.43	146.11	0.308	0.183	0.00022	0.11	0.003	16
MA- 15-3	MA-1C	0.75	2.43	146.11	0.305	0.186	0.00022	0.11	0.006	16
MA- 16-1	MA-1A	0.75	2.43	236.73	0.329	0.280	0.00045	0.16	0.082	16
MA- 16-2	MA-1B	0.75	2.43	236.73	0.335	0.265	0.00045	0.15	0.027	16
MA- 16-3	MA-1C	0.75	2.43	236.73	0.338	0.259	0.00045	0.14	0.046	16
MA- 17-1	MA-1A	0.75	2.43	259.38	0.329	0.302	0.00050	0.17	0.091	16
MA- 17-2	MA-1B	0.75	2.43	259.38	0.332	0.293	0.00050	0.16	0.030	16
MA- 17-3	MA-1C	0.75	2.43	259.38	0.332	0.290	0.00050	0.16	0.049	16
MA- 18-1	MA-1A	0.75	2.43	380.30	0.329	0.451	0.00062	0.25	0.213	16
MA- 18-2	MA-1B	0.75	2.43	380.30	0.329	0.427	0.00062	0.24	0.085	16
MA- 18-3	MA-1C	0.75	2.43	380.30	0.335	0.433	0.00062	0.24	0.128	16
MA- 19-1	MA-1A	0.75	2.43	477.14	0.335	0.549	0.00098	0.30	0.226	16
MA- 19-2	MA-1B	0.75	2.43	477.14	0.335	0.558	0.00098	0.31	0.180	16
MA- 19-3	MA-1C	0.75	2.43	477.14	0.305	0.646	0.00098	0.37	0.201	16

Table 4. Summary of Sand-Scour Experiments in Sedimentation Flume for Set 3 (runs 20-27)

Run ID	Mixture ID	Median Diameter D_{50} (mm)	Gradation Coefficient σ_g	Flow Discharge Q (l/s)	Approach Depth Y (m)	Approach Velocity V (m/s)	Energy Slope S_e	Froude Number Fr	Scour Depth D_s (m)	Flow Duration t (h)
MA-20-1	MA-2E	0.75	3.40	147.25	0.305	0.195	0.00047	0.11	0.003	16
MA-20-2	MA-2D	0.75	3.40	147.25	0.308	0.189	0.00047	0.11	0.003	16
MA-20-3	MA-3	0.75	1.38	147.25	0.308	0.186	0.00047	0.11	0.009	16
MA-21-1	MA-2E	0.75	3.40	184.06	0.341	0.207	0.00050	0.11	0.009	16
MA-21-2	MA-2D	0.75	3.40	184.06	0.338	0.210	0.00050	0.12	0.012	16
MA-21-3	MA-3	0.75	1.38	184.06	0.338	0.213	0.00050	0.12	0.040	16
MA-22-1	MA-2E	0.75	3.40	206.71	0.323	0.250	0.00054	0.14	0.012	16
MA-22-2	MA-2D	0.75	3.40	206.71	0.329	0.241	0.00054	0.13	0.015	16
MA-22-3	MA-3	0.75	1.38	206.71	0.332	0.238	0.00054	0.13	0.064	16
MA-23-1	MA-2E	0.75	3.40	259.38	0.335	0.305	0.00062	0.17	0.018	16
MA-23-2	MA-2D	0.75	3.40	259.38	0.335	0.299	0.00062	0.16	0.021	16
MA-23-3	MA-3	0.75	1.38	259.38	0.338	0.293	0.00062	0.16	0.128	16
MA-24-1	MA-2E	0.75	3.40	314.32	0.326	0.387	0.00070	0.22	0.030	16
MA-24-2	MA-2D	0.75	3.40	314.32	0.329	0.378	0.00070	0.21	0.052	16
MA-24-3	MA-3	0.75	1.38	314.32	0.326	0.381	0.00070	0.21	0.213	16
MA-25-1	MA-2E	0.75	3.40	379.45	0.332	0.451	0.00090	0.25	0.070	16
MA-25-2	MA-2D	0.75	3.40	379.45	0.332	0.436	0.00090	0.24	0.085	16
MA-25-3	MA-3	0.75	1.38	379.45	0.335	0.430	0.00090	0.24	0.250	16
MA-26-1	MA-2E	0.75	3.40	478.55	0.317	0.591	0.00150	0.34	0.189	16
MA-26-2	MA-2D	0.75	3.40	478.55	0.317	0.582	0.00150	0.33	0.189	16
MA-27-1	MA-2E	0.75	3.40	518.20	0.299	0.674	0.00200	0.39	0.219	16
MA-27-2	MA-2D	0.75	3.40	518.20	0.299	0.652	0.00200	0.38	0.201	16

Table 5. Summary of Sand-Scour Experiments in Hydrodynamics Flume for Sets 4-7

Run ID	Mixture ID	Median Diameter D_{50} (mm)	Gradation Coefficient σ_g	Pier Diameter *b* (m)	Flow Discharge *Q* (l/s)	Approach Depth *Y* (m)	Approach Velocity *V* (m/s)	Froude Number *Fr*	Bed Slope S_o	Scour Depth D_s (m)	Flow Duration *t* (h)
HN-01-1	HN-1	1.87	3.70	0.051	6.91	0.040	0.207	0.33	0.00418	0.010	8
HN-01-2	HN-1	1.87	3.70	0.051	6.91	0.050	0.165	0.23	0.00418	0.003	8
HN-01-3	HN-1	1.87	3.70	0.070	6.91	0.056	0.143	0.19	0.00418	0.004	8
HN-02-1	HN-1	1.87	3.70	0.051	13.79	0.065	0.436	0.54	0.00418	0.025	8
HN-02-2	HN-1	1.87	3.70	0.051	13.79	0.073	0.351	0.41	0.00418	0.009	8
HN-02-3	HN-1	1.87	3.70	0.070	13.79	0.080	0.314	0.35	0.00418	0.013	8
HN-03-1	HN-1	1.87	3.70	0.051	10.90	0.061	0.354	0.46	0.00363	0.015	8
HN-03-2	HN-1	1.87	3.70	0.051	10.90	0.071	0.271	0.32	0.00363	0.008	8
HN-03-3	HN-1	1.87	3.70	0.070	10.90	0.074	0.235	0.28	0.00363	0.008	8
HN-04-1	HN-1	1.87	3.70	0.051	17.58	0.075	0.488	0.57	0.00336	0.028	10
HN-04-2	HN-1	1.87	3.70	0.051	17.58	0.079	0.399	0.45	0.00336	0.012	10
HN-04-3	HN-1	1.87	3.70	0.070	17.58	0.081	0.354	0.40	0.00336	0.014	10
HN-05-1	HN-1	1.87	3.70	0.051	20.67	0.075	0.521	0.61	0.00368	0.032	10
HN-05-2	HN-1	1.87	3.70	0.051	20.67	0.078	0.451	0.52	0.00368	0.027	10
HN-05-3	HN-1	1.87	3.70	0.070	20.67	0.078	0.421	0.48	0.00368	0.036	10
HN-10-1	HN-2	1.87	1.15	0.051	6.91	0.075	0.162	0.19	0.00375	0.002	11
HN-10-2	HN-2	1.87	1.15	0.051	6.91	0.088	0.128	0.14	0.00375	0.000	11
HN-10-3	HN-2	1.87	1.15	0.070	6.91	0.101	0.110	0.11	0.00375	0.000	11
HN-11-1	HN-2	1.87	1.15	0.051	9.00	0.077	0.216	0.25	0.00375	0.007	9
HN-11-2	HN-2	1.87	1.15	0.051	9.00	0.087	0.158	0.17	0.00375	0.000	9
HN-11-3	HN-2	1.87	1.15	0.070	9.00	0.101	0.140	0.14	0.00375	0.000	9
HN-12-1	HN-2	1.87	1.15	0.051	10.90	0.075	0.256	0.30	0.00391	0.048	14
HN-12-2	HN-2	1.87	1.15	0.051	10.90	0.085	0.189	0.21	0.00391	0.009	14
HN-12-3	HN-2	1.87	1.15	0.070	10.90	0.098	0.158	0.16	0.00391	0.014	14
HN-13-1	HN-2	1.87	1.15	0.051	12.35	0.078	0.274	0.31	0.00418	0.058	21
HN-13-2	HN-2	1.87	1.15	0.051	12.35	0.088	0.204	0.22	0.00418	0.012	21
HN-13-3	HN-2	1.87	1.15	0.070	12.35	0.101	0.180	0.18	0.00418	0.017	21
HN-14-1	HN-2	1.87	1.15	0.051	13.79	0.077	0.387	0.44	0.00417	0.077	19
HN-14-2	HN-2	1.87	1.15	0.051	13.79	0.088	0.296	0.32	0.00417	0.042	19
HN-14-3	HN-2	1.87	1.15	0.070	13.79	0.100	0.247	0.25	0.00417	0.018	19
HN-20-1	HN-2	1.87	1.15	0.051	16.88	0.073	0.445	0.53	0.00417	0.078	30
HN-20-2	HN-2	1.87	1.15	0.051	16.88	0.089	0.344	0.37	0.00417	0.066	30
HN-20-3	HN-2	1.87	1.15	0.070	16.88	0.097	0.290	0.30	0.00417	0.061	30
HN-21-1	HN-3	1.8	2.17	0.051	10.90	0.085	0.212	0.23	0.00341	0.012	17
HN-21-2	HN-3	1.8	2.17	0.051	10.90	0.091	0.189	0.20	0.00341	0.003	17
HN-21-3	HN-3	1.8	2.17	0.070	10.90	0.097	0.149	0.15	0.00341	0.007	17
HN-22-1	HN-3	1.8	2.17	0.051	13.79	0.087	0.273	0.30	0.00341	0.014	22
HN-22-2	HN-3	1.8	2.17	0.051	13.79	0.094	0.244	0.25	0.00341	0.012	22
HN-22-3	HN-3	1.8	2.17	0.070	13.79	0.097	0.213	0.22	0.00341	0.012	22
HN-23-1	HN-3	1.8	2.17	0.051	16.88	0.088	0.342	0.37	0.00341	0.031	25

Table 5. Summary of Sand-Scour Experiments in Hydrodynamics Flume (continued)

Run ID	Mixture ID	Median Diameter D_{50} (mm)	Gradation Coefficient σ_g	Pier Diameter b (m)	Flow Discharge Q (l/s)	Approach Depth Y (m)	Approach Velocity V (m/s)	Froude Number F_r	Bed Slope S_o	Scour Depth D_s (m)	Flow Duration t (h)
HN-23-3	HN-3	1.8	2.17	0.070	16.88	0.095	0.258	0.27	0.00341	0.020	25
HN-24-1	HN-3	1.8	2.17	0.051	20.70	0.088	0.410	0.44	0.00323	0.048	24
HN-24-2	HN-3	1.8	2.17	0.051	20.70	0.087	0.377	0.41	0.00323	0.042	24
HN-29-3	HN-4	0.76	1.28	0.070	7.56	0.098	0.122	0.12	0.00000	0.002	8
HN-30-1	HN-4	0.76	1.28	0.051	9.74	0.076	0.232	0.27	0.00000	0.062	20
HN-30-2	HN-4	0.76	1.28	0.051	9.74	0.086	0.170	0.19	0.00000	0.024	20
HN-30-3	HN-4	0.76	1.28	0.070	9.74	0.096	0.152	0.16	0.00000	0.017	20
HN-31-1	HN-4	0.76	1.28	0.051	11.95	0.079	0.261	0.30	0.00000	0.081	21
HN-31-2	HN-4	0.76	1.28	0.051	11.95	0.091	0.191	0.20	0.00000	0.058	21
HN-31-3	HN-4	0.76	1.28	0.070	11.95	0.101	0.174	0.18	0.00000	0.047	21
HN-32-1	HN-4	0.76	1.28	0.051	13.79	0.079	0.298	0.34	0.00000	0.085	23
HN-32-2	HN-4	0.76	1.28	0.051	13.79	0.091	0.255	0.27	0.00000	0.066	23
HN-32-3	HN-4	0.76	1.28	0.070	13.79	0.101	0.205	0.21	0.00000	0.083	23

Table 6. Summary of River-Mechanics Flume Experiments to Study Pier-Width Effects for Set 8

Run ID	Mixture ID	Median Diameter D_{50} (mm)	Gradation Coeficient σ_g	Pier Diameter b (m)	Approach Depth Y (m)	Approach Velocity V (m/s)	Bed Slope S_o (m/m)	Froude Number Fr	Scour Depth D_s (m)	Flow Duration t (h)
MH 11-1	MH-1	0.55	2.24	0.216	0.238	0.244	0.001	0.160	0.045	16
MH 10-1	MH-1	0.55	2.24	0.216	0.157	0.448	0.001	0.361	0.196	16
MH 9-1	MH-1	0.55	2.24	0.216	0.198	0.371	0.001	0.266	0.153	16
MH 8-1	MH-1	0.55	2.24	0.216	0.212	0.255	0.001	0.177	0.060	16
MH 7-1	MH-1	0.55	2.24	0.216	0.255	0.272	0.001	0.172	0.079	16
MH 6-1	MH-1	0.55	2.24	0.216	0.239	0.257	0.001	0.168	0.072	16
MH 5-1	MH-1	0.55	2.24	0.216	0.246	0.290	0.001	0.187	0.120	16
MH 12-1	MH-1	0.55	2.24	0.152	0.237	0.280	0.001	0.184	0.088	16
MH 13-1	MH-1	0.55	2.24	0.152	0.210	0.253	0.001	0.176	0.069	16
MH 14-1	MH-1	0.55	2.24	0.152	0.224	0.274	0.001	0.185	0.089	16
MH 15-1	MH-1	0.55	2.24	0.152	0.244	0.316	0.001	0.205	0.116	16
MH 16-1	MH-1	0.55	2.24	0.152	0.214	0.282	0.001	0.195	0.081	16
MH 17-1	MH-1	0.55	2.24	0.152	0.290	0.517	0.001	0.307	0.248	16
MH 18-1	MH-1	0.55	2.24	0.152	0.247	0.361	0.001	0.232	0.191	16
MH 19-1	MH-1	0.55	2.24	0.152	0.224	0.307	0.001	0.207	0.111	16
MH 11-3	MH-1	0.55	2.24	0.165	0.219	0.246	0.001	0.168	0.049	16
MH 10-3	MH-1	0.55	2.24	0.165	0.138	0.465	0.001	0.400	0.143	16
MH 9-3	MH-1	0.55	2.24	0.165	0.182	0.408	0.001	0.305	0.158	16
MH 8-3	MH-1	0.55	2.24	0.165	0.194	0.265	0.001	0.192	0.065	16
MH 7-3	MH-1	0.55	2.24	0.165	0.237	0.307	0.001	0.201	0.088	16
MH 11-2	MH-1	0.55	2.24	0.089	0.238	0.240	0.001	0.157	0.037	16
MH 10-2	MH-1	0.55	2.24	0.089	0.157	0.479	0.001	0.385	0.117	16
MH 9-2	MH-1	0.55	2.24	0.089	0.198	0.349	0.001	0.250	0.111	16
MH 8-2	MH-1	0.55	2.24	0.089	0.212	0.238	0.001	0.165	0.066	16
MH 7-2	MH-1	0.55	2.24	0.089	0.255	0.270	0.001	0.171	0.077	16
MH 6-2	MH-1	0.55	2.24	0.089	0.239	0.276	0.001	0.180	0.073	16
MH 11-4	MH-1	0.55	2.24	0.057	0.219	0.235	0.001	0.160	0.035	16
MH 10-4	MH-1	0.55	2.24	0.057	0.138	0.436	0.001	0.374	0.057	16
MH 9-4	MH-1	0.55	2.24	0.057	0.182	0.378	0.001	0.283	0.068	16
MH 8-4	MH-1	0.55	2.24	0.057	0.194	0.250	0.001	0.181	0.036	16
MH 7-4	MH-1	0.55	2.24	0.057	0.237	0.276	0.001	0.181	0.032	16
MH 10-5	MH-1	0.55	2.24	0.032	0.138	0.463	0.001	0.398	0.029	16
MH 9-5	MH-1	0.55	2.24	0.032	0.182	0.413	0.001	0.309	0.037	16
MH 8-5	MH-1	0.55	2.24	0.032	0.194	0.266	0.001	0.193	0.022	16
MH 7-5	MH-1	0.55	2.24	0.032	0.237	0.305	0.001	0.200	0.038	16
MH 10-6	MH-1	0.55	2.24	0.019	0.157	0.437	0.001	0.352	0.014	16
MH 9-6	MH-1	0.55	2.24	0.019	0.198	0.339	0.001	0.243	0.034	16
MH 8-6	MH-1	0.55	2.24	0.019	0.212	0.219	0.001	0.152	0.018	16

Table 7. Summary of Gravel-Scour Experiments in Sedimentation Flume for Sets 9 and 10

Run ID	Mixture ID	Median Diameter D_{50} (mm)	Gradation Coefficient σ_g	Pier Diameter b (m)	Approach Depth Y (m)	Approach Velocity V (m/s)	Bed Slope S_o (m/m)	Froude Number F_r	Scour Depth D_s (m)	Flow Duration t (h)
MH G1-1	MH-2	16.90	1.28	0.178	0.296	0.850	0.0007	0.499	0.049	16
MH G2-1	MH-2	16.90	1.28	0.178	0.320	1.073	0.0007	0.605	0.073	16
MH G3-1	MH-2	16.90	1.28	0.178	0.338	1.192	0.0007	0.654	0.110	16
MH G4-1	MH-2	16.90	1.28	0.178	0.354	1.228	0.0007	0.659	0.113	16
MH G5-1	MH-2	16.90	1.28	0.178	0.372	1.384	0.0007	0.724	0.113	16
MH G6-1	MH-2	16.90	1.28	0.178	0.290	1.859	0.0007	1.103	0.110	16
MH G7-1	MH-2	16.90	1.28	0.178	0.238	2.286	0.0007	1.497	0.271	16
MH G1-2	MH-3	16.70	1.30	0.178	0.335	0.771	0.0007	0.425	0.073	16
MH G2-2	MH-3	16.70	1.30	0.178	0.357	0.969	0.0007	0.518	0.085	16
MH G3-2	MH-3	16.70	1.30	0.178	0.381	1.079	0.0007	0.558	0.119	16
MH G4-2	MH-3	16.70	1.30	0.178	0.357	1.186	0.0007	0.634	0.152	16
MH G5-2	MH-3	16.70	1.30	0.178	0.375	1.320	0.0007	0.688	0.183	16
MH G6-2	MH-3	16.70	1.30	0.178	0.250	2.018	0.0007	1.288	0.235	16
MH G7-2	MH-3	16.70	1.30	0.178	0.219	2.478	0.0007	1.688	0.305	16

4.4 Theoretical Analysis

This section presents the parameters affecting pier scour in non-uniform mixtures, and derives relationships to quantify their effects on the resulting scour depths. The equations derived from this analysis are were tested with the data from the experimental study and with data from earlier studies.

4.4.1. Governing Parameters

Experiments conducted for sets 1-3 varied the size gradation and coarse-material fraction of six sand mixtures while keeping their median diameter constant. In these experiments, the flow depth was kept relatively constant and the pier diameter remained 0.18 m while the discharge into the flume was incremented. Since the channel width and flow depth remained constant, this discharge variation in the experiments corresponded to varying velocity while keeping all other flow parameters constant. Figure 4.1 shows the variation of dimensionless scour depth in experiments in sets 1-3 with approach velocity. By keeping all other variables constant, these experiments isolated the effects of gradation and coarse material fraction on pier scour.

As shown in Figure 4.1, the initiation of pier scour takes place independent of the size of coarse-material fractions for approach velocities of approximately 0.18 m/s. This velocity is termed the *scour initiation velocity*, V_i, and marks the threshold condition for clear-water scour. For approach velocities greater than V_i, the largest scour depth in Figure 4.1 takes place in uniform-sediment mixtures (gradation coefficient σ_g = 1.38). As the size-gradation coefficient increases from 1.38 to 2.43, then to 3.4, the depth of scour decreases. This finding is in agreement with previous research. However, the reduction of scour is not a constant factor as suggested by earlier studies, but is a function of flow intensity. While the largest scour reduction takes place for an intermediate velocity value, for velocities slightly greater than 0.18 m/s and for velocities greater than 0.6 m/s, the scour reduction remains small.

Figure 4.1 also shows two mixtures with the same median-sediment sizes and gradation coefficients, but with enlarged coarse fractions. In mixtures identified as 2.38A and 2.38B, while D_{50} and σ_g were kept at 0.75 mm and 2.43 respectively, the coarsest 5-percent and 10-percent fractions were enlarged by replacing these size groups with coarser sediments. As a result, as shown in Figure 4.1, the scour depths corresponding to these mixtures are smaller. In fact, the scour observed for the mixture with an enlarged coarsest 10-percent fraction (mixture 2.43A) is the same as the scour observed in mixture 3.4A with a gradation coefficient of 3.4. Similarly, introducing larger coarse fractions to mixture 3.4A resulted in further reduction in scour depth.

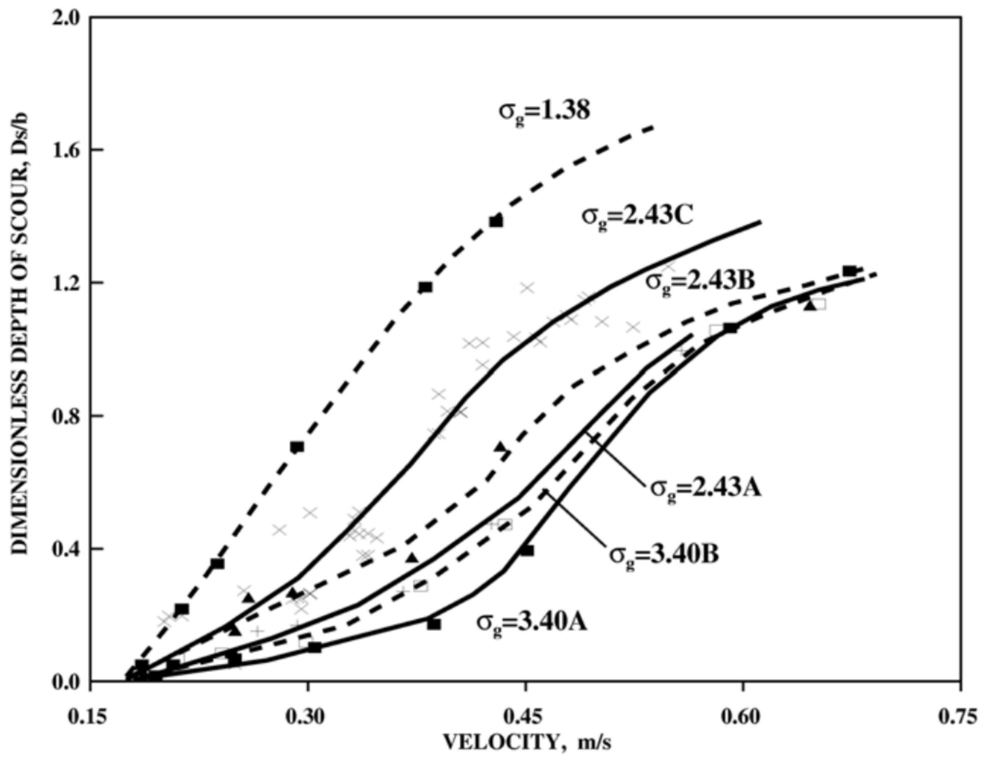


Figure 4.1. Variation of scour depth with velocity for sand mixtures used in sets 1-3

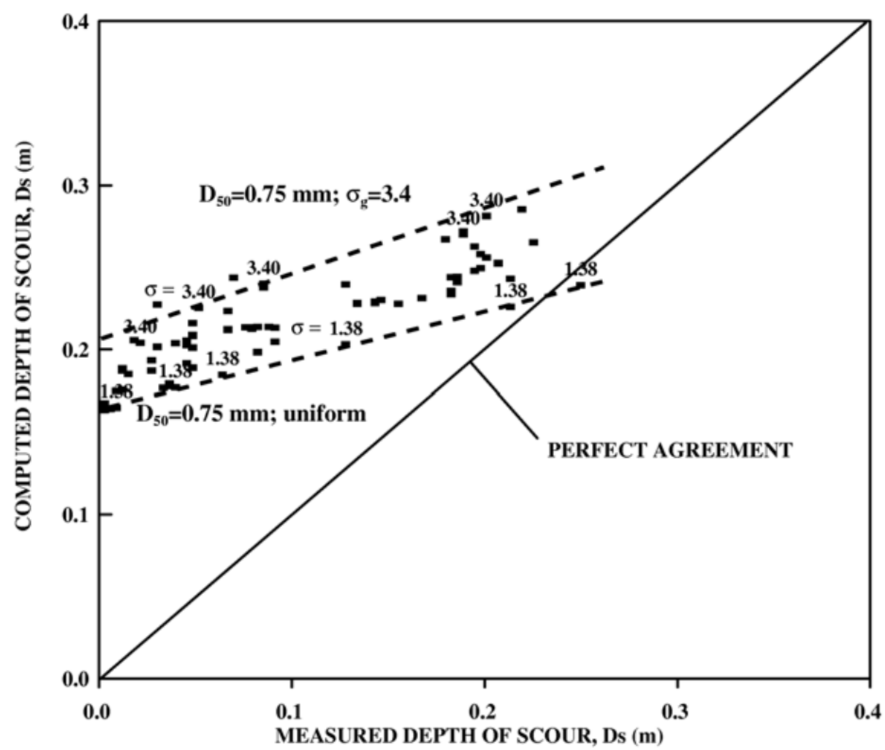


Figure 4.2. Comparison of FHWA's CSU equation with the measured scour from sets 1-3

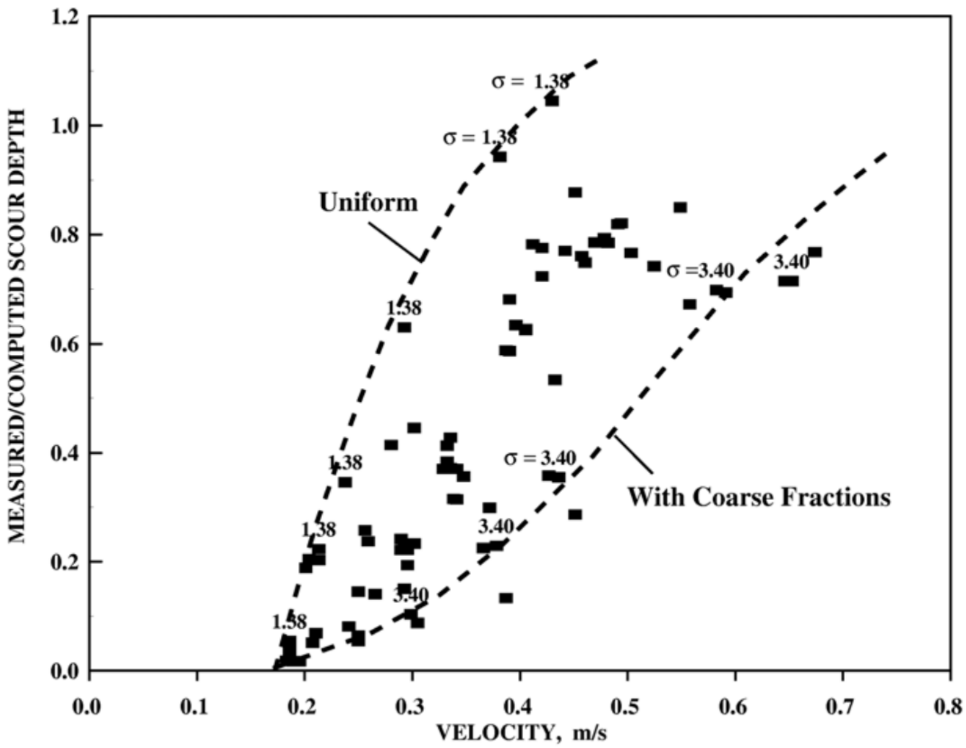


Figure 4.3. Velocity versus discrepancy ratio for sets 1-3 experiments

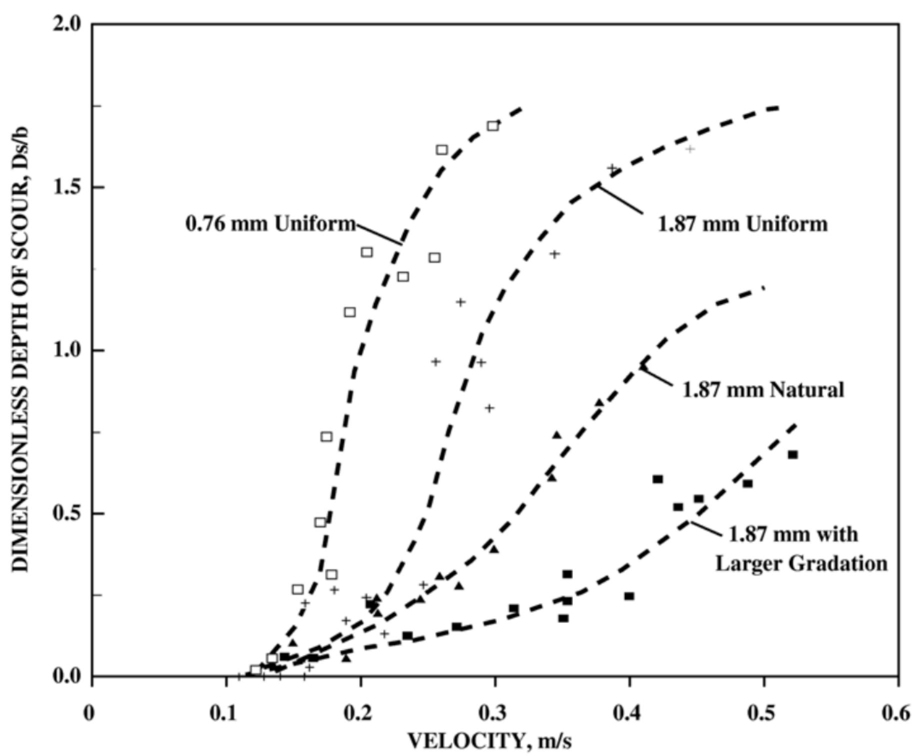


Figure 4.4. Flow velocity versus dimensionless scour for sets 4-7 experiments

Figure 4.2 compares the results of sets 1-3 experiments with the computed-scour values from the Colorado State University (CSU) equation given in FHWA's HEC-18. Several observations can be made in Figure 4.2:

- As the intensity of flow increases (indicated by larger scour depth) the computed-scour depths approach the measured values;
- For larger gradation factors and for mixtures with larger coarse fractions, the convergence of computed and measured values takes place at higher flow intensities; and
- At low-flow intensities the computed values are in the order of 8 to 10 times the measured values.

In Figure 4.3 the ratio of measured-to-computed scour depth is plotted against the flow velocity for the experiments in sets 1-3. For this data the ratio approaches 1 (perfect agreement) as the flow velocity (or intensity) increases. For a given flow velocity the ratio is closer to 1 for uniform mixtures (illustrated in the figure by the 1.38 gradation coefficient above the plotted points) than for mixtures with large size variations (illustrated by the 3.40 gradation coefficient above the plotted points). A general conclusion from Figures 4.2 and 4.3 is that the discrepancy between measured- and computed-scour depths using the current CSU equation increases as the gradation coefficient increases, and as the velocity (or flow intensity) decreases.

Figure 4.4 shows results from experiments in sets 4-7 conducted using coarser sediment mixtures, and compares these results with the finer uniform-sand mixture used in sets 1-3. In these experiments smaller depths and pier diameters were used. Without applying proper modeling-scale ratios for flow depth and pier diameter the results cannot be superimposed on the previous results. However, the pattern of scour-depth variation with flow intensity remains identical. In both Figures 4.1 and 4.4 the relationship between velocity and D_s/b shows, that for uniform material, the variation of scour with velocity is almost linear. For graded material and material with larger coarse fractions this relationship assumes the characteristics of a 2nd or 3rd degree polynomial (concave). At high flow velocities both figures show that scour values tend to converge to an "ultimate" value. The velocity at which maximum clear-water scour takes place is a function of the size of coarsest-size fractions present in mixtures. This velocity is identified as the critical velocity, V_c , at which the entire bed is mobilized (live-bed conditions).

It is possible to define a dimensionless excess velocity, P, which is a relative velocity with respect to the critical velocity that fully mobilizes the bed, given by:

$$\psi = \frac{V - V_i}{V_c - V_i}; \qquad 0 \le \psi \le 1 \tag{4}$$

The value of ψ varies between 0 and 1, with 0 corresponding to initiation of scour and 1 corresponding to the condition of fully-mobilized bed. The values of V_i and V_c can be determined by relating these

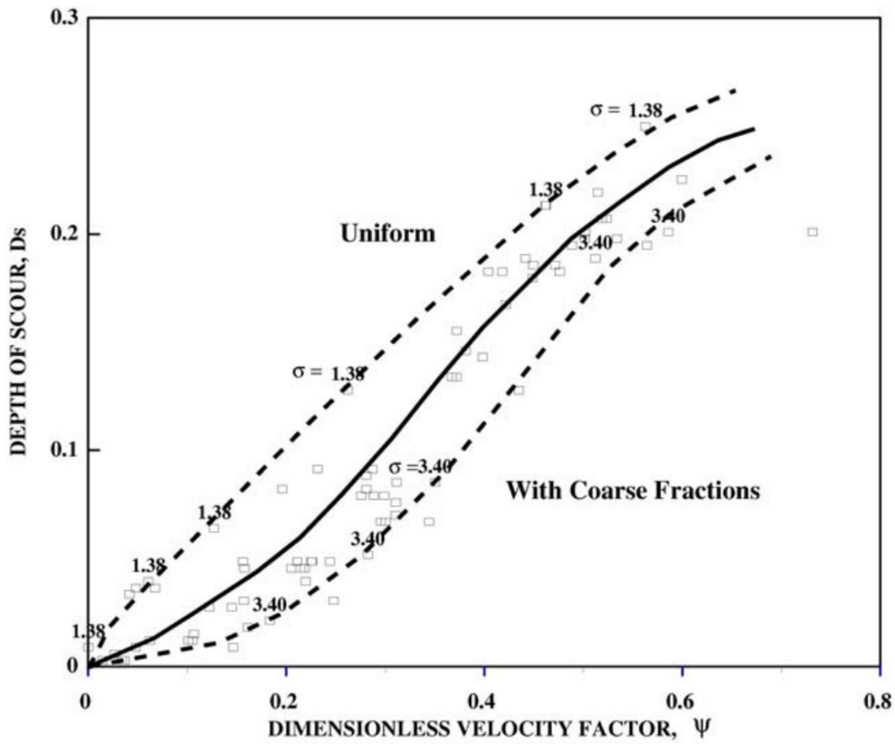


Figure 4.5. Dimensionless excess velocity factor, ψ, versus depth of scour for sets 1-3

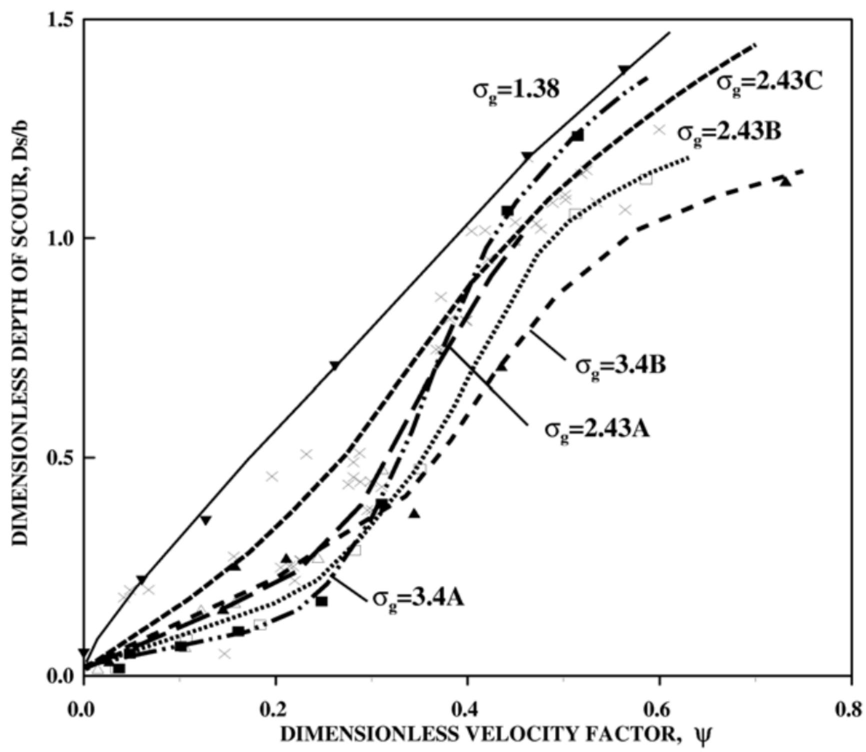


Figure 4.6. Variation of dimensionless scour with excess-velocity factor for various mixtures

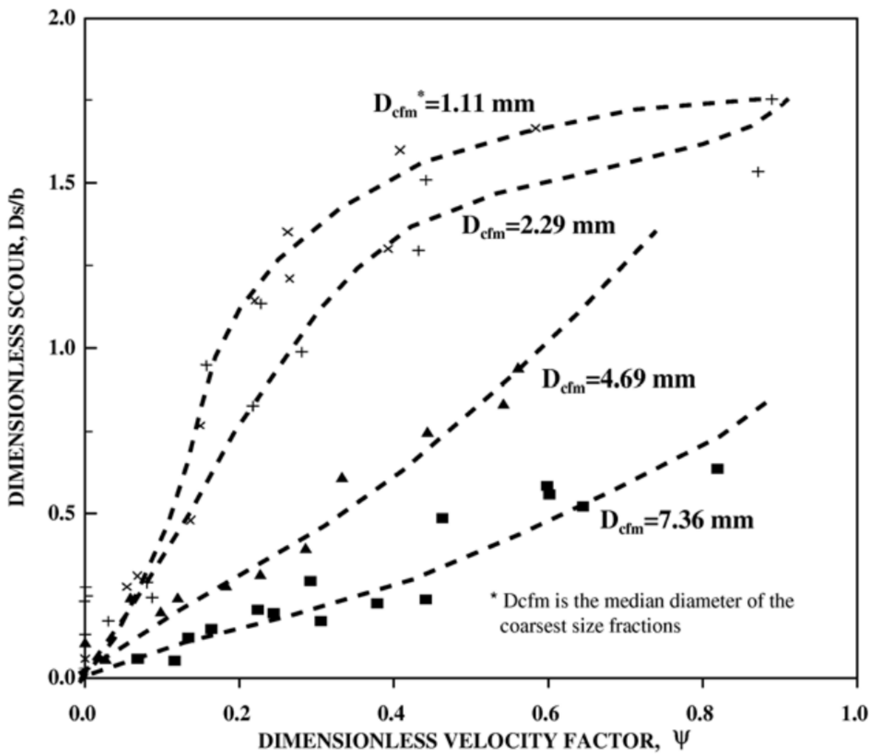


Figure 4.7. Variation of dimensionless scour with excess-velocity factor, ψ, for different coarse-fraction sizes used in sets 4-7 experiments

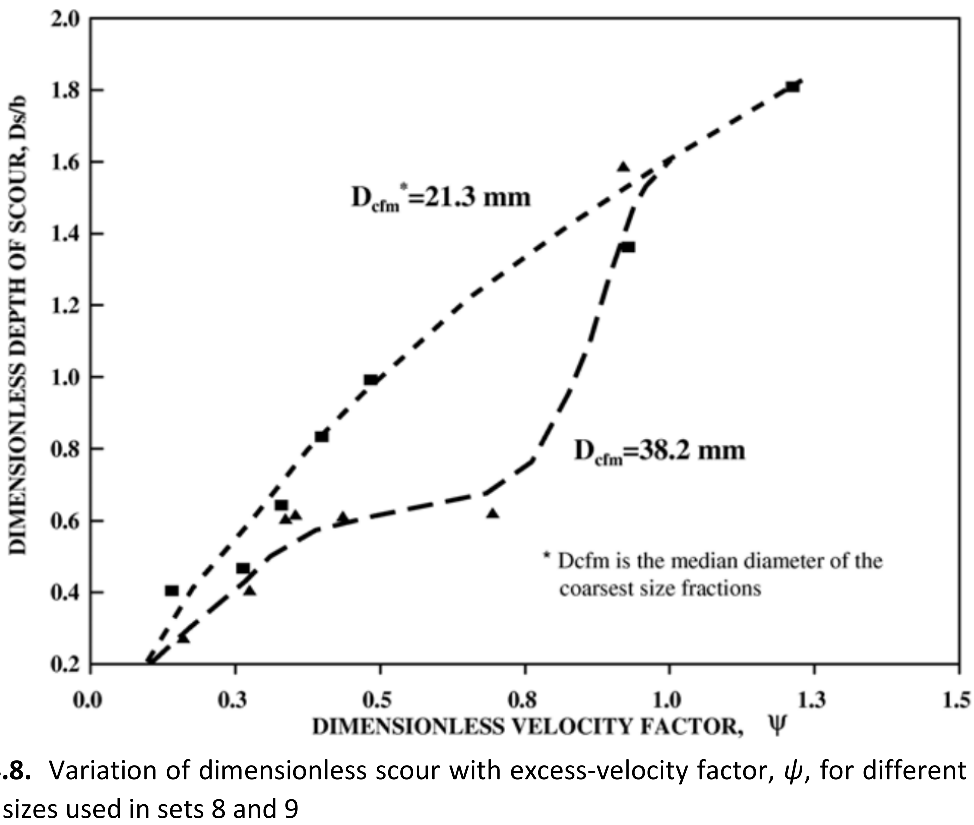


Figure 4.8. Variation of dimensionless scour with excess-velocity factor, ψ, for different coarse-fraction sizes used in sets 8 and 9

velocities to critical-flow conditions corresponding to initiation of motion. Using Shields' relationship for critical shear

$$\tau_c = K\gamma_s' D_r \tag{5}$$

or,

$$\gamma R S = K\gamma_s' D_r \tag{6}$$

Where τ_c = critical shear; K = experimental constant (0.047); γ_s' = submerged specific weight of sediment (1.65); R = hydraulic radius; S = slope of the energy grade line; and D_r = characteristic sediment size.

For critical conditions, using the Manning-Strickler equation to express the slope of the energy line in terms of approach velocity ($S = V_c^2\, n^2 / R^{2/3}$, where V_c and R are in metric units), and using a relationship expressing the roughness coefficient, n, in terms of the characteristic sediment size ($n = D_r^{1/6}/26.1$, where D_r is in meters) it is possible to obtain:

$$\gamma \frac{V_c^2 D_r^{1/3}}{26.1^2 R^{1/3}} = 0.047\, \gamma_s'\, D_r \tag{7}$$

or,

$$V_c = 26.1 \sqrt{\frac{0.047\ \gamma_s'}{\gamma}}\, D_r^{1/3} R^{1/6} = K_*\ D_r^{1/3} R^{1/6} \tag{8}$$

where V_c, R, and D_r are in SI units. Replacing γ_s'/γ with 1.65 and after simplifications, equation 8 reduces to

$$V_c\,(\text{m/s}) = 7.27\, D_r\,(\text{m})^{1/3}\, Y(\text{m})^{1/6}$$

In English units, the critical velocity expression becomes

$$V_c\ (\text{ft/sec}) = 13.2\, D_r\,(\text{ft})^{1/3}\, Y\,(\text{ft})^{1/6}$$

For the purposes of this study, however, the constant K_* in equation 8 is an experimentally-determined value. Using results of pier-scour experiments, K_* was found to be 6.625 for SI units (with D_r in meters) and 12 for English units (with D_r in feet). In order to reflect the characteristics of the coarse-material fractions, the representative sediment size, D_r, is defined by the median size of the coarse-material fraction, D_{cfm}, given by:

$$D_{cfm} = \frac{D_{85} + 2D_{90} + 2D_{95} + D_{99}}{6} \tag{9}$$

The parameter D_{cfm} is a representative size (in meters for SI units, and feet for English units) for the coarse fractions present in sediment mixtures. Experimental evidence in Figures 4.1 and 4.4 indicates that a fully-

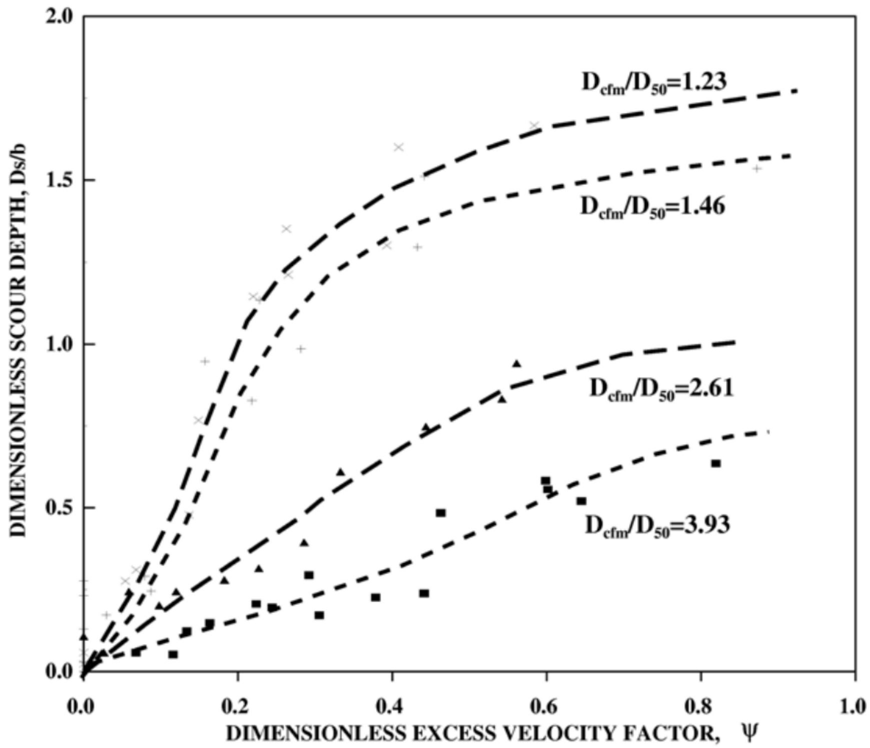


Figure 4.9. Variation of scour depth with excess-velocity factor, ψ, for different coarse-fraction size ratios used in sets 4-7 experiments

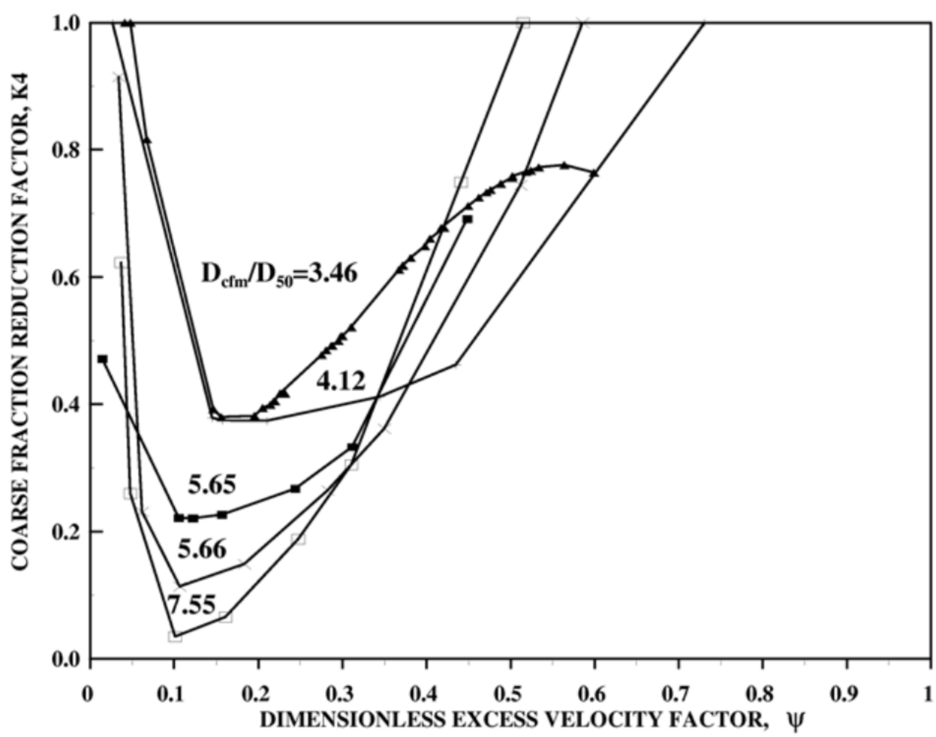


Figure 4.10. Variation of measured coarse-fraction reduction factor, K_4, with excess-velocity factor, ψ, for sets 1-3 experiments

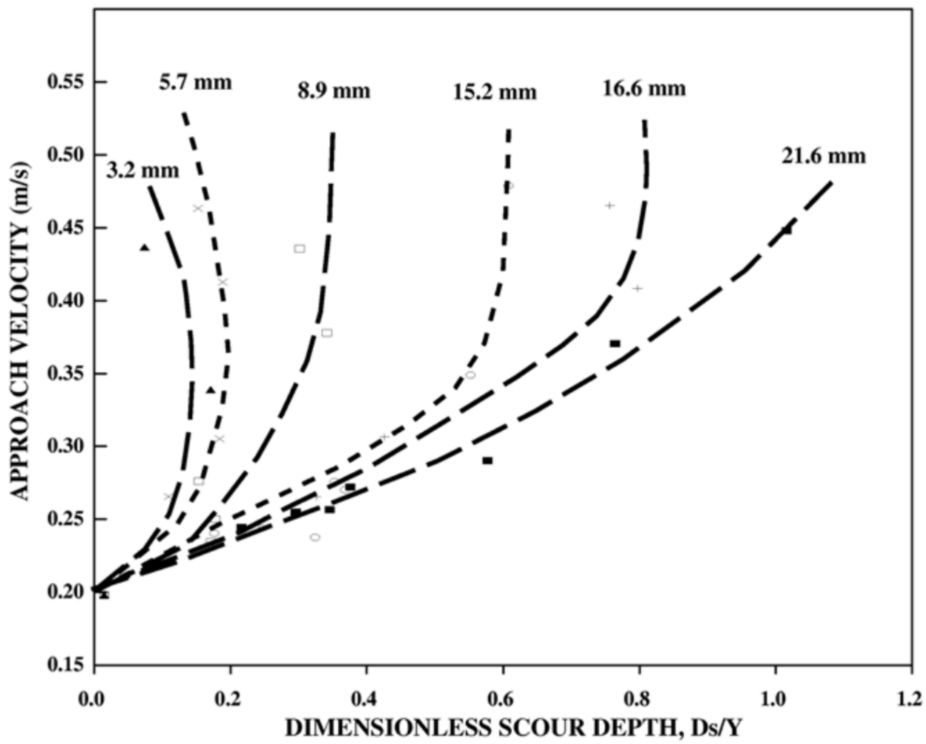


Figure 4.11. Variation of scour depth with pier size for the set 8 experiments

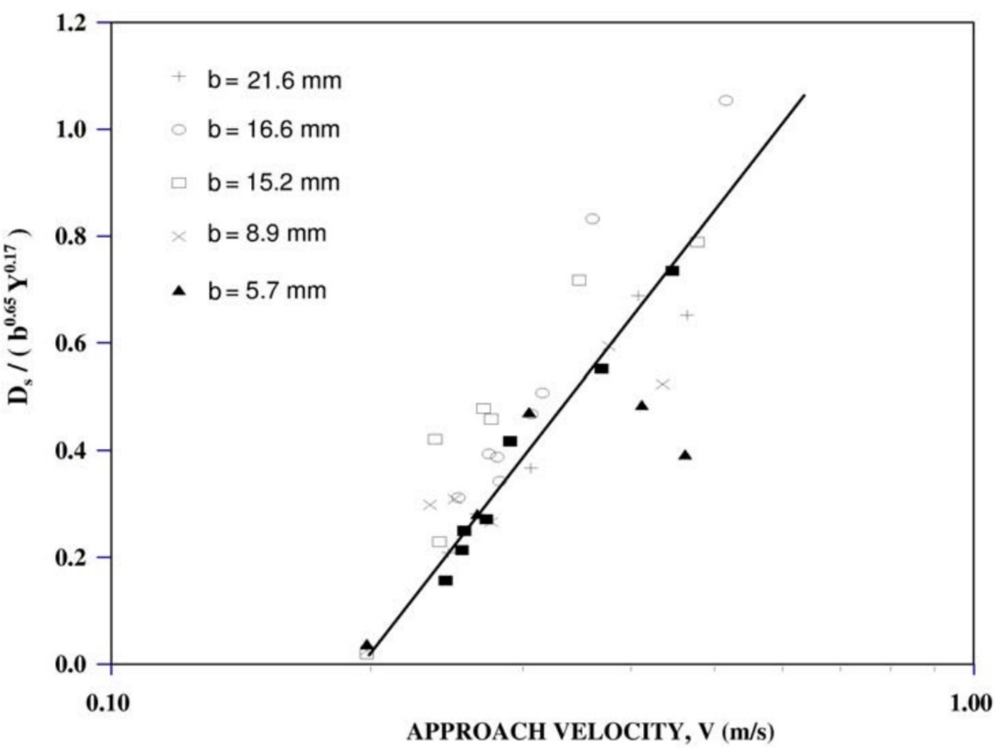


Figure 4.12. Relationship describing variation of pier scour with diameter

mobilized bed cannot be achieved without mobilizing coarser sizes. In the absence of extensive size information, or in cases where there are no discontinuities in the size-gradation curves, it is possible to utilize D_{90} to represent coarse fractions.

Velocities in the vicinity of piers are amplified. From potential-flow theory, this amplification is approximately 1.7 times the approach velocity. Scour initiation takes place when the accelerated flows past the pier are capable of removing the bed material from the pier region. Experimental evidence indicates that these velocities are dependent on the finer-size fractions that are significantly available in the bed.

For this study, the representative size for initiation of motion was determined to be D_{35}. This size was used in the sedimentation literature by Einstein, Ackers, and White to account for the gradation effects in the transport of bed material. The expression for the initiation of pier scour can be derived from the critical-velocity relationship, and can be expressed as:

$$V_{\mathrm{i}} = K'' D_{35}^{1/3}\, Y^{1/6} \tag{10}$$

Where K'' is an experimental coefficient. From the pier-scour experiments, the value of K'' was found to be 2.65 for SI units using D_{35} in meters, and 4.8 for English units using D_{35} in feet.

Using the dimensionless velocity factor ψ the data presented earlier in Figure 4.1 is expressed in Figure 4.5. This figure shows that while maximum-scour depth is reached at ψ = 0.6 for the uniform mixture, for graded sediments higher flow intensities may be needed. This figure also shows that for mixtures with coarse fractions, low relative-flow intensities produce significantly smaller scour depths. For these mixtures, ultimate scour is produced sharply beyond a threshold intensity. Figure 4.5 indicates that even though the ultimate scour might be the same, for intermediate flows different mixtures exhibit different scour patterns. The information in Figure 4.5 is reproduced in Figure 4.6 in non-dimensional form.

Figures 4.7 and 4.8 present dimensionless velocity versus depth of scour for sets 4-9. In these figures the parameter D_{cfm} is used to differentiate between mixtures with the same median size and gradation coefficient. As shown, the representative coarse fraction size, D_{cfm}, can reliably identify mixtures and, therefore, can be used in relationships to quantify the associated scour depths. In general, for the same dimensionless velocity factor, smaller D_{cfm} values are associated with larger scour depths. However, a more reliable factor in differentiating sediment properties of mixtures is the ratio, $D_{\mathrm{cfm}} / D_{50}$, used in Figure 4.9. This dimensionless parameter can be used to normalize different sediment sizes for their expected scour potential. In Figure 4.9, D_{cfm} /D_{50} values of 1.23 and 1.46 represent two uniform mixtures with median sizes of 1.80 mm and 0.75 mm, respectively. For a given dimensionless velocity factor, the mixture with the larger sediment size but with smaller D_{cfm} /D_{50} ratio produces larger scour holes. This experimental observation can be used to formulate an expression by relating scour to flow intensity (as represented by dimensionless flow velocity factor, ψ) and the relative coarse-fraction size D_{cfm} /D_{50}.

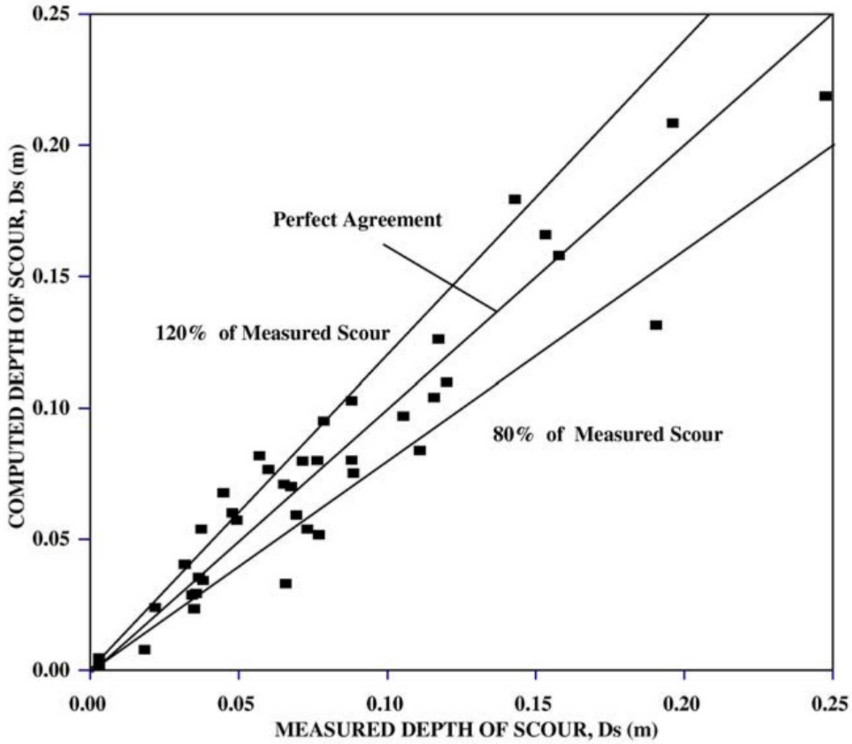


Figure 4.13. Computed and measured scour depths for the set 8 experiments

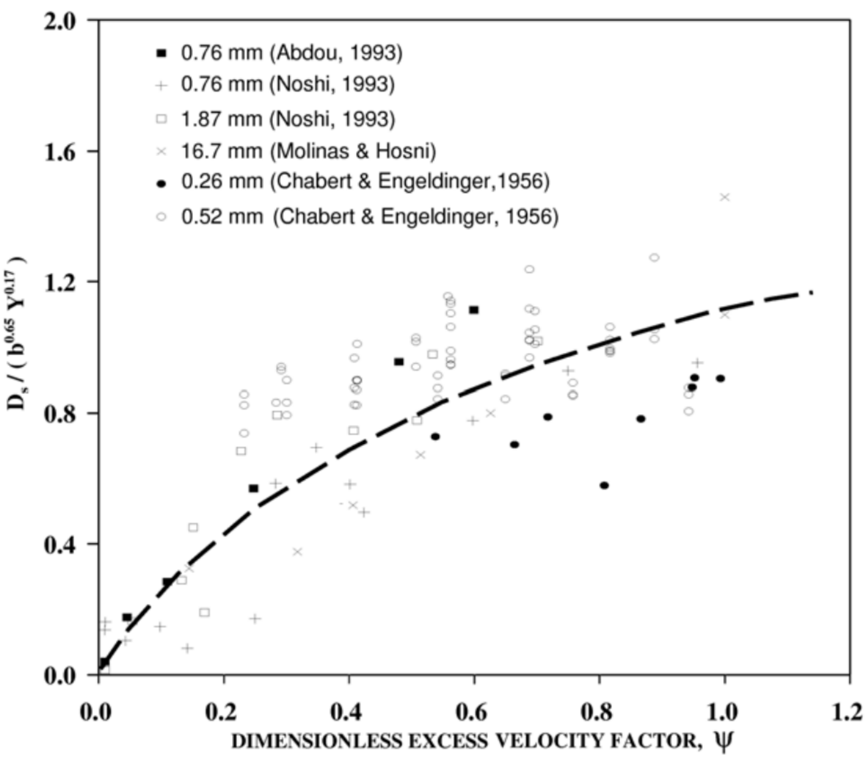


Figure 4.14. Variation of scour depth with excess-velocity factor, ψ, for uniform sand and gravel

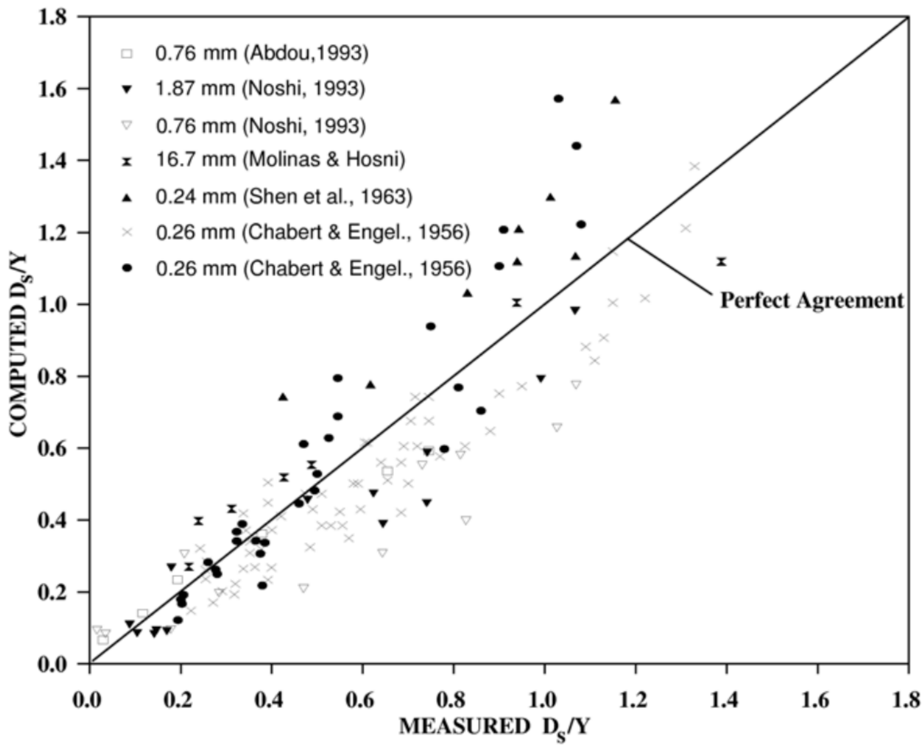


Figure 4.15. Measured and computed depth of scour for uniform sands and gravel using equation 12

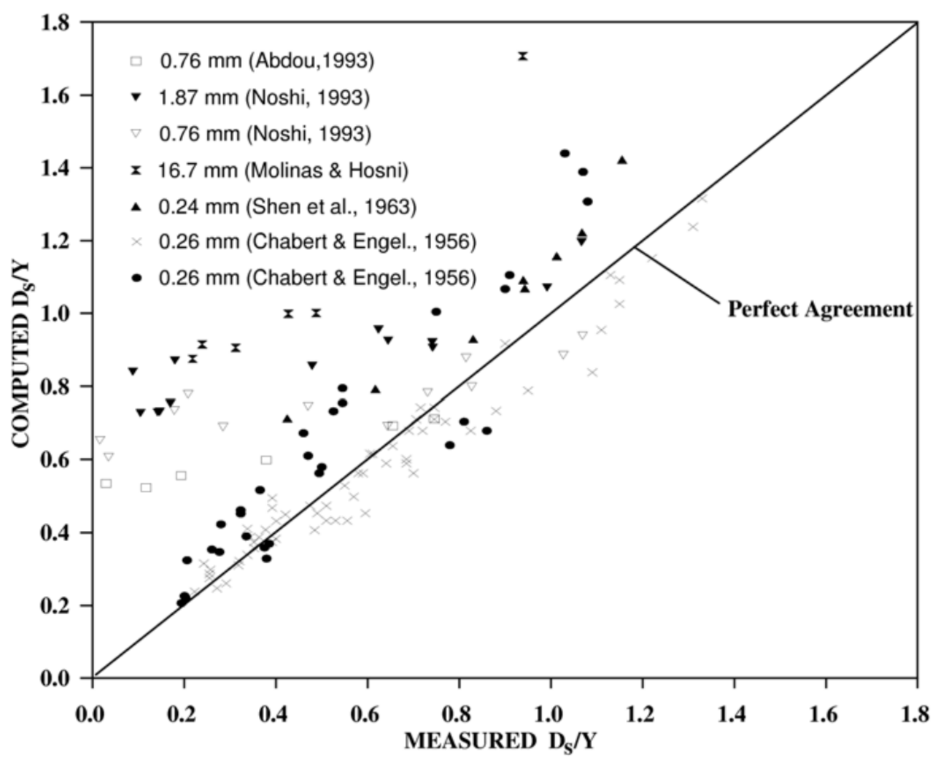


Figure 4.16. Measured and computed scour for uniform sediment using FHWA's CSU equation

To achieve this goal, it is necessary first to evaluate scour taking place in uniform material. Then, ratios of scour values observed in mixtures with varying amounts of coarse material compared with scour in uniform material must be evaluated. This ratio, which is termed the *coarse-fraction reduction factor* and denoted by K_4, must then be related to flow intensity and D_{cfm}/D_{50}. Figure 4.10 shows the results of this procedure for experiments in sets 1-3. Several conclusions can be drawn from Figure 4.10:

- Scour reduction due to presence of coarse material cannot be expressed with a single value.
- Scour reduction is a function of the coarse-sediment-fraction ratio D_{cfm}/D_{50}. The higher the ratio, the lower the minimum value of K_4.
- For low flow intensities, and therefore ψ values near zero, the K_4 value must be unity, since at low flow intensities there could be no effects due to coarse fractions or gradation.
- For high flow intensities, and therefore ψ values near or greater than unity, the K_4 value must also approach unity. At high flow intensities with a fully-mobilized bed, effects due to the presence of coarse fractions must be minimal.
- There exists a certain flow intensity ψ at which scour reduction is minimum for a given sediment mixture. The location and magnitude of the minimum depend on the distribution and modality of sediment mixtures.

4.4.2. Derivation of the K_4 Relationship

Two steps are needed in order to derive a functional relationship for K_4 — express pier scour in uniform mixtures, and separate the effects due to the presence of coarse fractions.

Set 8 experiments (Table 6) were used to define the variation of local scour with pier diameter. Figures 4.11 and 4.12 show the variation of dimensionless scour depth with approach velocity for the six pier diameters used in the study. Since the flow depth was kept relatively constant for these experiments and the investigation of these effects was beyond the scope of the experimental study, the commonly accepted depth dependency of $Y^{1/6}$ was assumed for this study in normalizing the results. The best-fit line for describing the variation of scour with pier width in the pier-width-effect experiments utilizing 0.55-mm graded sand and the corresponding correlation coefficient are given by:

$$\frac{D_s}{b^{0.66}Y^{0.17}} = 0.97\psi^{0.72}; \qquad R^2 = 0.90 \tag{11}$$

where D_s, b, and Y are in meters and R^2 is the correlation coefficient. This relationship demonstrates that scour is related to pier diameter according to:

$$D_s \propto b^{0.66}$$

The goodness of fit of this relationship is shown in Figure 4.13.

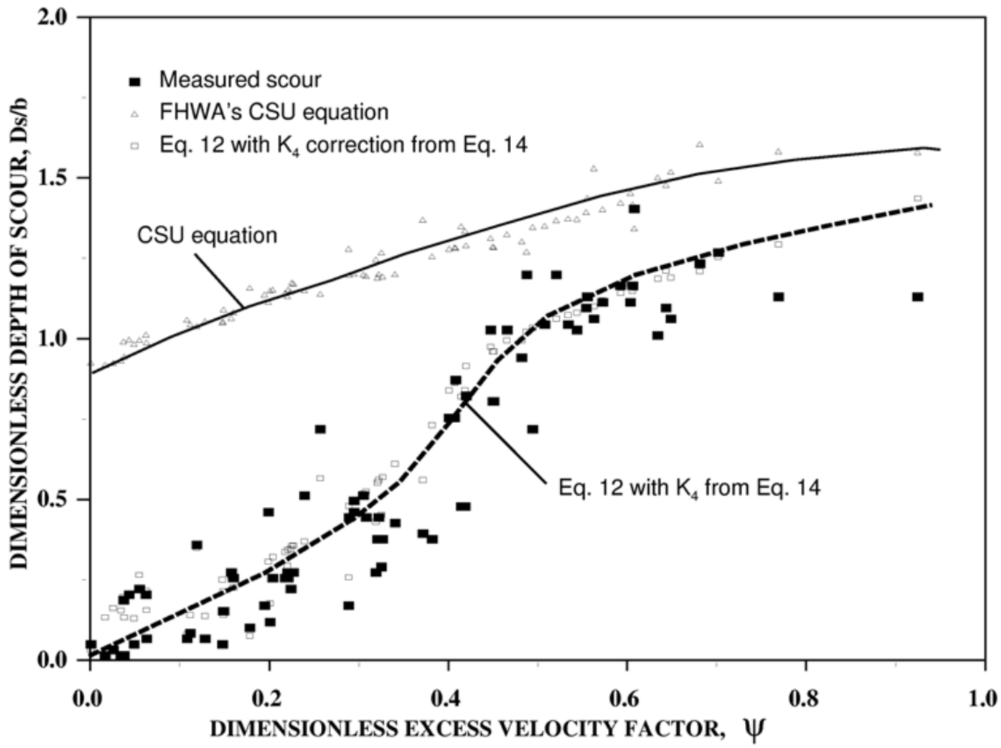


Figure 4.17. Computed scour for sets 1-3 experiments using equation 12 with K_4 from equation 14

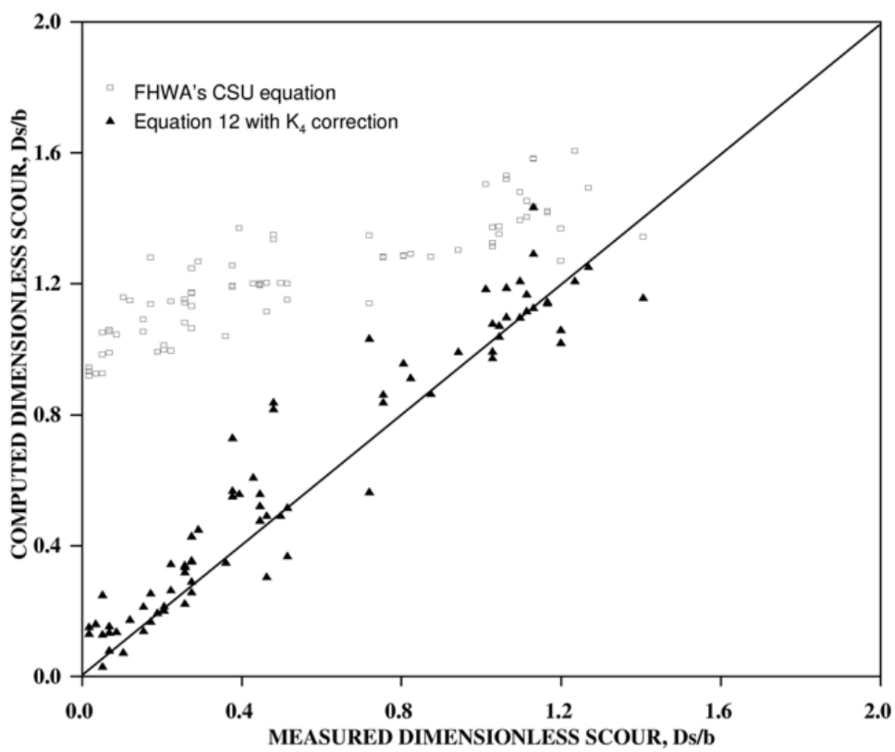


Figure 4.18. Measured and computed scour for nonuniform-sand experiments in sets 1-3

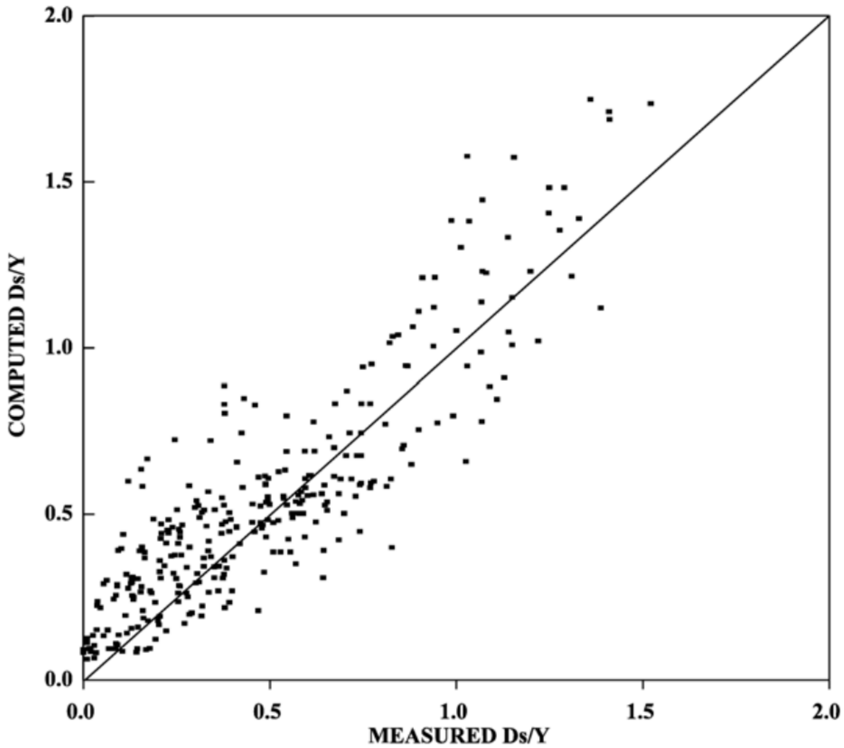


Figure 4.19. Computed and measured scour for all data using equation 12 (uniform-mixture equation)

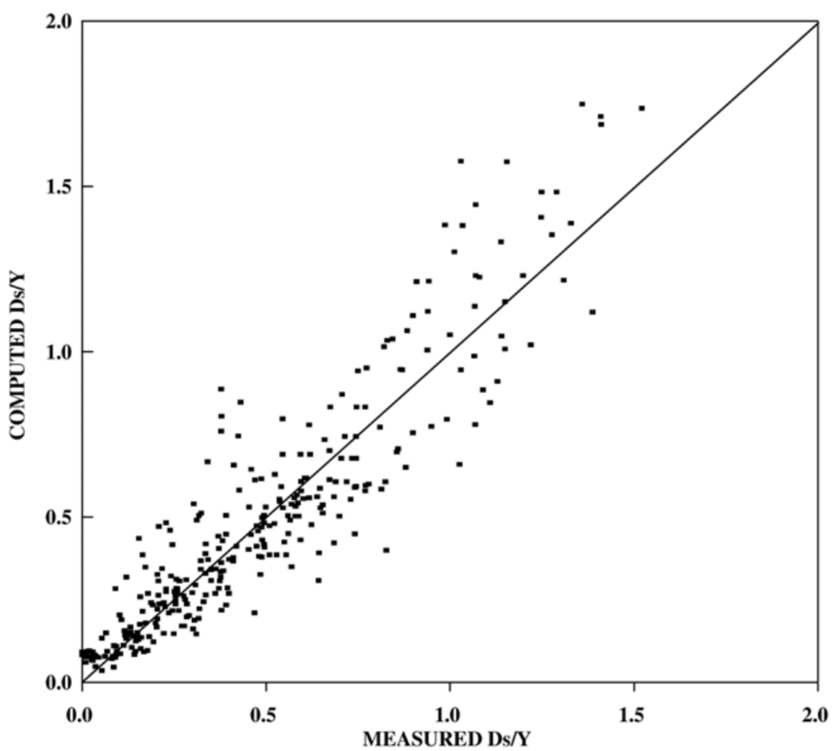


Figure 4.20. Computed and measured scour for all data using equation 12 with K_4 correction from equation 14

Next, utilizing $D_s /(b^{0.66} Y^{0.17})$ and ψ as variables, an expression for pier scour in uniform mixtures was developed. For this purpose, experiments with median-sediment sizes ranging from 0.75 mm to 1.80 mm, and to 17 mm were utilized. The resulting expression in SI units is:

$$\frac{D_s}{b^{0.66}\,Y^{0.17}} = 0.99\ \psi^{0.55}; \qquad 0 \le \psi \le 1 \tag{12}$$

in which D_s, b, and Y are in meters. For English units the expression becomes:

$$\frac{D_s}{b^{0.66}\,Y^{0.17}} = 1.21\ \psi^{0.55}; \qquad 0 \le \psi \le 1 \tag{13}$$

In using these equations a limiting value of 1 must be imposed on ψ to reflect maximum clear-water scour conditions. Figures 4.14 and 4.15 show the goodness of fit of the data to this equation. In Figure 4.15 additional data (126 points) from Chabert and Engeldinger (1956) and Shen, Schneider, Karaki (1966) which were used in the development of FHWA's CSU equation are included. This demonstrates the agreement of the new equation with other data sources. For comparison purposes, Figure 4.16 presents the same uniform-material data with the CSU equation. As expected, for coarse material and gravel the CSU equation does not perform well.

The last step in the development was the derivation of an expression to separate the effects due to coarse material fractions. This expression was derived through an extensive search for a function that could describe the physical phenomenon explained earlier in Figure 4.10. Those conditions are:

- At low flow intensities ($\psi < 0$), effects due to coarse fraction are negligible, since at these flows only finer fractions are scoured;
- At high flow intensities ($\psi > 0$), effects due to coarse fraction are also negligible, since at these flows the entire mixture is mobilized;
- At intermediate flow intensities scour reduction is a function of both ψ and D_{cfm}/D_{50} ; and
- Maximum scour reduction takes place for ψ = 0.1 to 0.3.

The resulting expression is:

$$K_4 = 1.25 + 3\sqrt{\frac{D_{cfm}}{D_{50}}}\ \psi^{0.60}\ \ln(\psi + 0.5); \qquad 0 \le K_4 \le 1,\ 0 \le \psi \le 1 \tag{14}$$

where ψ is the dimensionless excess velocity from equation 4.

Figure 4.17 shows the data from set 1-3 experiments along with predictions from FHWA's CSU equation and the new K_4 relationship. The goodness of fit is illustrated in Figure 4.18. As shown in the figures, at low flow intensities and in the presence of coarse material the correlation of the CSU equation was poor.

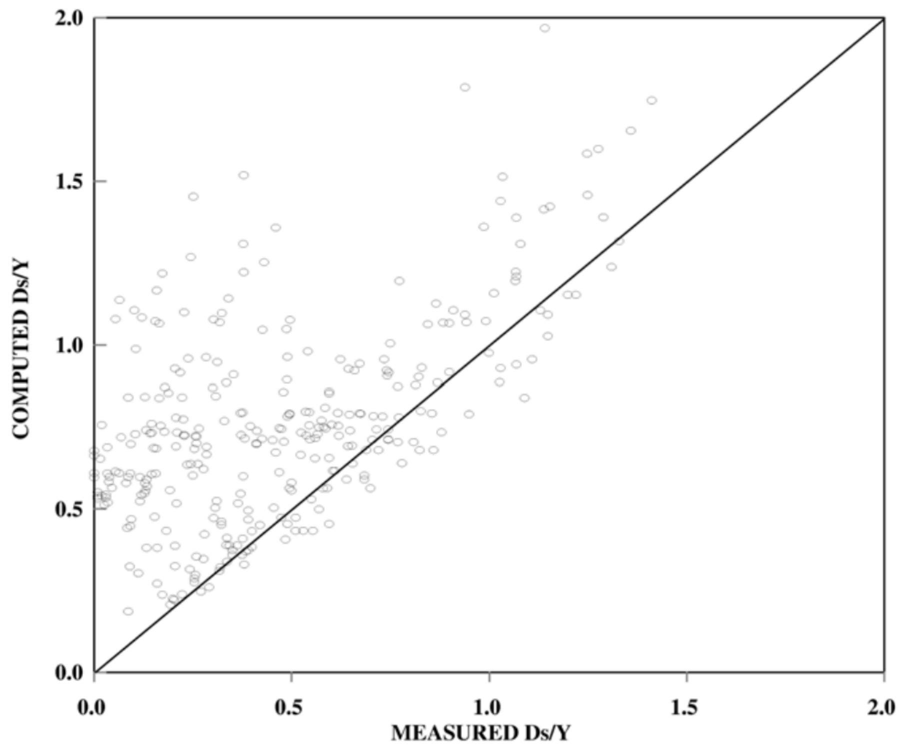


Figure 4.21. Computed scour using FHWA's CSU equation for uniform and nonuniform mixtures

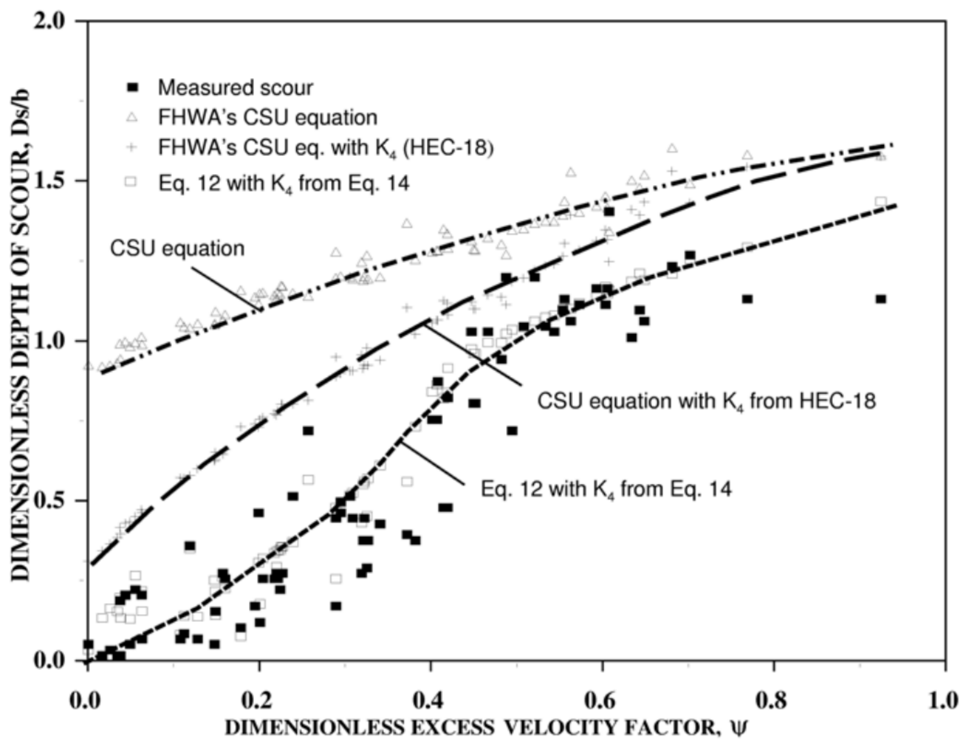


Figure 4.22. Computed scour using FHWA's CSU equation with and without K_4 correction from HEC 18, and by using the newly-developed equation 12 with K_4 correction from equation 14

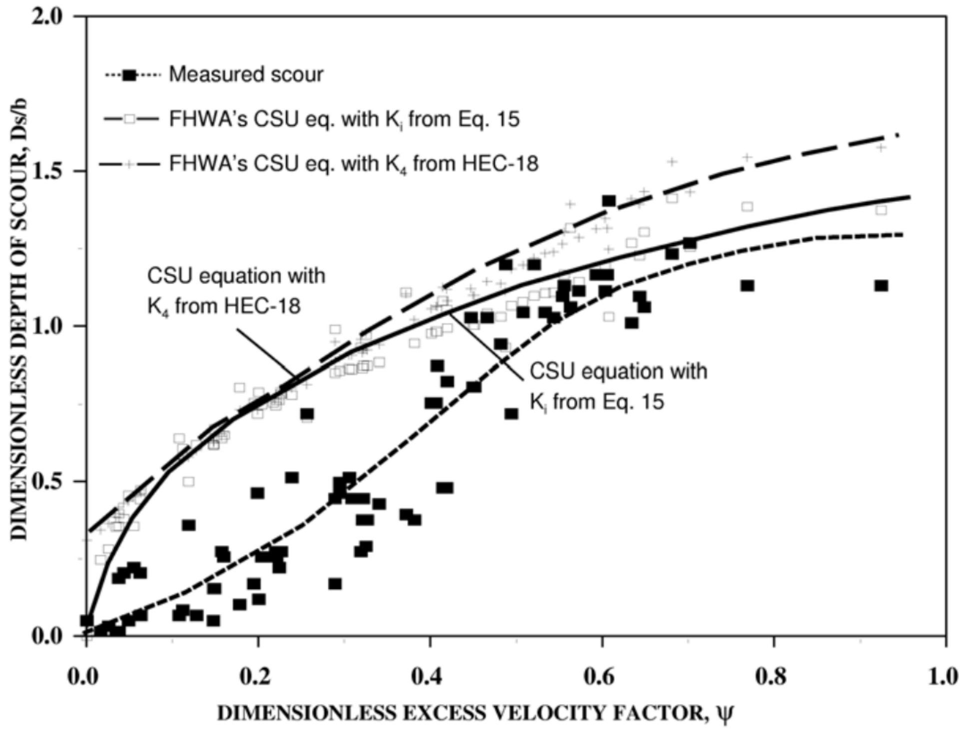


Figure 4.23. Comparison of FHWA's CSU equation with K_4 correction (according to HEC 18) and the initiation of motion correction, K_i (according to equation 15)

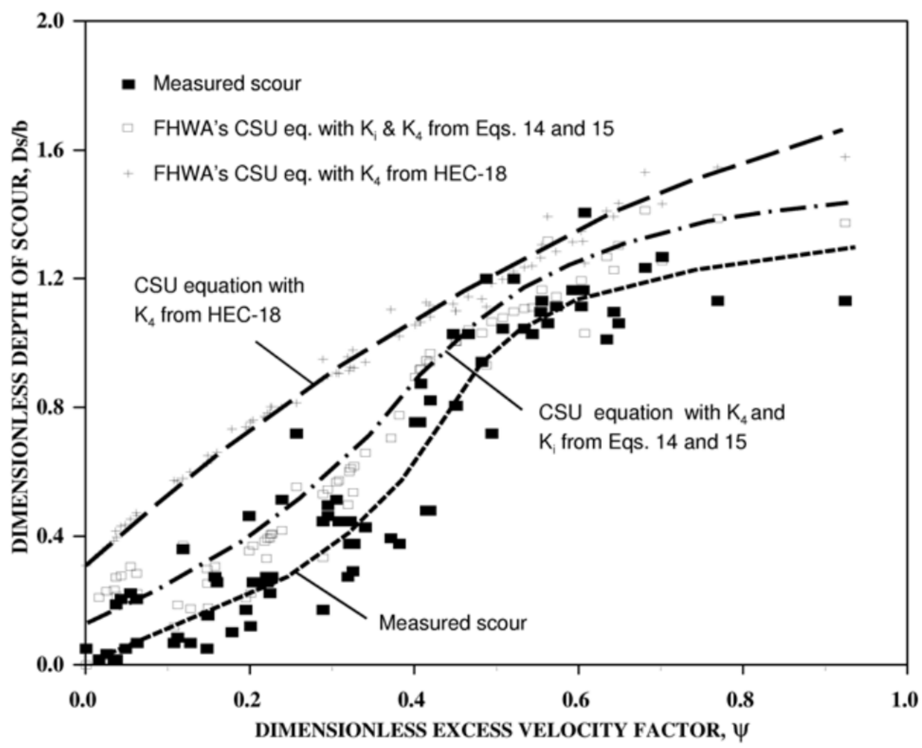


Figure 4.24. FHWA's CSU equation adjusted with K_i and K_4, and with the HEC 18 correction for K_4

However, at high flow intensities the CSU predictions converged with the new method and measurements.

Figures 4.19 and 4.20 show the new equations with all data available from this study, and with the data from earlier studies that was used in the development of the earlier CSU equation (a total of 310 data values). The performance of the CSU equation with the same data set is illustrated in Figure 4.21.

4.5 Adjustments to FHWA's CSU Pier-Scour Equation

Figure 4.22 compares the present HEC-18 correction for coarse-material size with the new approach. As shown, modifications proposed in HEC-18 cannot fully accommodate size corrections since this factor does not involve any sizes, and provides maximum correction at $\psi = 0$ (the no-scour condition).

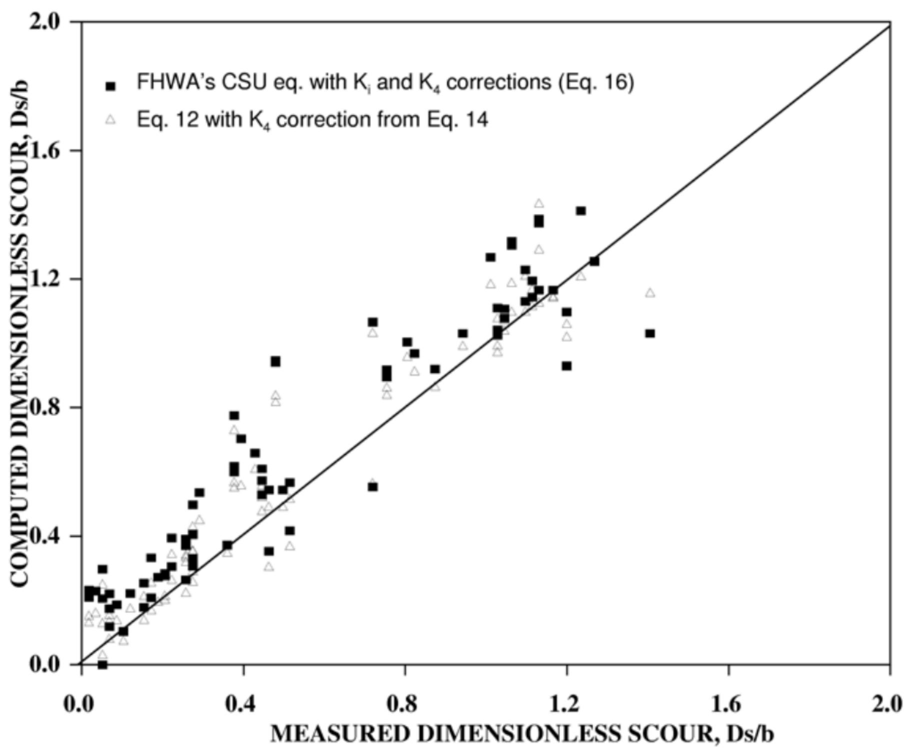


Figure 4.25. Comparison between computed and measured scour using K_i and K_4 corrections to FHWA's CSU equation (equation 16), and by using equation 12 with the K_4 correction from equation 14

From the analysis of all data, it is concluded that two adjustments to FHWA's CSU equation are needed:

- Implementation of initiation of scour for uniform mixtures with larger sediment diameters than those used in the derivation of the model; and
- Implementation of gradation and coarse-fraction size correction for non-uniform sediment mixtures.

Since the equation was originally developed for fine sands, initiation of motion took place at very low velocities, and the need for this correction was not obvious. For coarser sediments at low flow intensities, the present analysis amplifies this deficiency. The initiation of scour may be implemented in the CSU equation by the inclusion of a scour initiation factor, K_i. This factor was found to be:

$$K_i = \left(1 - \frac{V_i}{V}\right)^{0.45} \quad ; \qquad V > V_i \tag{15}$$

For values of $V \leq V_i$, the value of the initiation of scour factor, K_i, is 0.

Figure 4.23 compares the adjusted scour computations with the presently-used K_4 adjustment. The results are almost identical. The reason for this is due to the fact that the current K_4 is merely a correction for the initiation of motion, since the expression used for K_4 in HEC-18 is independent of relative sizes.

The second adjustment to the CSU equation to implement gradation and coarse-fraction size correction for non-uniform sediment mixtures may be accomplished through the K_4 factor defined earlier:

$$K_4 = 1.25 + 3\sqrt{\frac{D_{cfm}}{D_{50}}}\ \psi^{0.60} \ln(\psi + 0.5); \qquad 0 \leq K_4 \leq 1,\ \ 0 \leq \psi \leq 1 \tag{16}$$

The final form of the CSU equation is:

$$\frac{D_s}{Y} = 2\ K_1\ K_2\ \ K_3\ K_i\ K_4 \left(\frac{b}{Y}\right)^{0.65} \left(\frac{V}{\sqrt{gY}}\right)^{0.43} \tag{17}$$

where the definition of terms K_1, K_2, and K_3 are as defined in HEC-18. Figures 4.24 and 4.25 show the results of pier-scour-depth computations using both K_i and K_4, and compare the results with the results from this study. As seen, a major improvement takes place in the predictions. The final results are comparable to those obtained from the study with slight overestimations.

4.6 Summary and Conclusions of Theoretical Development

A new pier-scour equation describing effects of gradation and coarse-material fraction on pier scour, D_s, was developed for Colorado streams. This equation is given as:

$$\frac{D_s}{b^{0.66}\,Y^{0.17}} = K_U\ K_1\ K_2\,K_3\,K_4\ \psi^{0.55}; \qquad 0 \leq \psi \leq 1 \tag{18}$$

where K_U = 2.0 for preferred English units, in which D_s, b (pier width), and Y (approach-flow depth) are in feet (1.64 for SI units, in which case D_s, b, and Y are in meters); K_1, K_2, and K_3 are as defined in HEC-18; and ψ equals the dimensionless excess-velocity factor given by:

$$\psi = \frac{V - V_i}{V_c - V_i}; \qquad 0 \le \psi \le 1 \tag{19}$$

The definitions of the critical and scour-initiating velocities, V_c and V_i, respectively, are:

$$V_c = K_c\, D_{cfm}^{1/3}\, Y^{1/6} \tag{20}$$

$$V_i = K_i\, D_{35}^{1/3}\, Y^{1/6} \tag{21}$$

where K_c = 12.0 for preferred English units (6.625 for SI units); K_i = 4.8 for preferred English units (2.65 for SI units); and D_{cfm} is the median size of the coarse-material fractions (in feet for English units, and meters for SI units) computed from:

$$D_{\mathrm{cfm}} = \frac{D_{85} + 2D_{90} + 2D_{95} + D_{99}}{6} \tag{22}$$

The coarse-fraction reduction factor K_4 is given by:

$$K_4 = 1.25 + 3\sqrt{\frac{D_{\mathrm{cfm}}}{D_{50}}}\;\psi^{0.60}\ln(\psi + 0.5); \qquad 0 \le K_4 \le 1,\ 0 \le \psi \le 1 \tag{23}$$

By definition, both K_4 and ψ cannot be greater than 1. The new equation has the following characteristics:

- For uniform mixtures, it accommodates the initiation of motion at low flow intensities; for velocities smaller than the scour initiating velocities, no scour is computed.
- The computed results are bounded by the imposition of a limiting condition for ψ of 1 (live-bed conditions).
- It is physically based with no scour reduction at initiation of motion, or at high flow intensities.
- Scour reduction is expressed as a function of relative coarse-fraction size and the intensity of flow.
- It was verified with past experimental data (170 points), including data used in the development of FHWA's CSU equation. It also showed excellent agreement with Jain and Fisher's data for supercritical flows.
- It was shown to be applicable to size ranges from 0.24-mm fine sand to 17-mm gravel mixtures.
- It was tested successfully with 370 data sets with close agreement.

The work on the existing FHWA CSU equation also provided very promising results. The adjustments needed for the FHWA equation are:

- Implementation of initiation of scour for uniform mixtures with larger sediment diameters than those used in the derivation of the model; and
- Implementation of gradation and coarse-fraction size correction for non-uniform sediment mixtures.

The initiation of scour is implemented in the CSU equation by the inclusion of the K_i factor. This factor was found to be:

$$K_i = \left(1 - \frac{V_i}{V}\right)^{0.45} \quad ; \qquad V > V_i \tag{24}$$

For values of $V < V_i$, the value of the initiation of scour factor, K_i , is 0.

Gradation and coarse-fraction size correction for non-uniform sediment mixtures is implemented in the CSU equation through the K_4 factor defined earlier as:

$$K_4 = 1.25 + 3\sqrt{\frac{D_{cfm}}{D_{50}}}\ \psi^{0.60} \ln(\psi + 0.5); \qquad 0 \le K_4 \le 1, \qquad 0 \le \psi \le 1 \tag{25}$$

The final form of the CSU equation is:

$$\frac{D_s}{Y} = 2\ K_1\ K_2\ \ K_3\ K_i\ K_4 \left(\frac{b}{Y}\right)^{0.65} \left(\frac{V}{\sqrt{gY}}\right)^{0.43} \tag{26}$$

where the terms K_1, K_2 , and K_3 are as defined in HEC-18.

5. DEVELOPMENT OF PIER-SCOUR EQUATION FOR COLORADO STREAMS

5.1 General

This chapter discusses testing the new scour equation given by Eq. 17 using data from Colorado streams. The proposed scour equation in English units was given in Chapter 4 and is:

$$\frac{D_s}{b^{0.66}\,Y^{0.17}} = 2.0\,K_1\;K_2\,K_3\,K_4\,\psi^{0.55}; \qquad 0 \le \psi \le 1$$

where

$$\psi = \frac{V - V_i}{V_c - V_i}; \qquad 0 \le \psi \le 1;$$

$$V_i = 4.8 D_{35}^{1/3}\,Y^{1/6}$$

$$V_c = 12 D_{cfm}^{1/3}\,Y^{1/6}$$

The Colorado streams used in the study are given Table 8. As shown in the table, 16 bridge sites were visited and data needed for the 40 pier-scour cases was obtained.

In general terms, the data needed for the analysis was:

1. General Site Information
    a. Photos of various bridge elements and piers
2. Bridge Properties (from as-built drawings)
    a. Pier size
    b. Bridge geometry and elevations
    c. Alignment of piers
3. Hydrology
    a. 100-year and 500-year return frequency discharges
4. Hydraulics
    a. Topography
    b. Roughness
    c. Losses
    d. Ineffective flow areas
5. Sediment Properties
    a. Bed-material size-gradation analyses
    b. Coarse-fraction data

6. Scour-Calculation Data
    a. Computed flow velocity
    b. Computed flow depth
    c. Initiation of bed-motion velocity
    d. Critical velocity for mobilizing the channel bed
    e. Excess velocity
7. Comparative Analysis
    a. Past CDOT scour-measurement records
    b. As-built plans
    c. Existing-ground elevations

Table 8. Colorado Streams Used in the Study

River	Colorado Highway	Structure ID		Number of Piers
Yampa River	SH 131	C-09-AR		2
Upper Colorado River	SH 131	E-10-A		3
Colorado River	I 70 AR	F-06-M		2
Colorado River	SH 340 EBND	H-02-S		8
Big Creek	SH 330	H-04-G		1
Plateau Creek	SH 330	H-04-S		1
Plateau Creek	SH 65	H-04-Z		1
East Muddy Creek	SH 133	H-07-H		2
Arkansas River	SH 300	H-11-AA		5
Lake Fork Creek	SH 300	H-11-U		2
North Fork Gunnison River	SH 187	I-06-C		2
Dolores River	SH 141	J-01-C		3
John Brown Creek	SH 141	J-01-D		1
Gunnison River	US 50	J-09-AB		2
Cebolla Creek	SH 149	K-08-D		2
Lake Fork Gunnison River	SH 149	L-07-A		2
Totals	**16**	**16**		**39**

For the current study, streams listed in Table 5 were visited to obtain coarse-material samples and additional site and bed-material information. Data, including bridge properties (pier size, bridge geometry and elevations), hydrology, hydraulic computations (approach velocities and depths at each pier), bed-material properties (size-gradation information for bed material), and data for comparative analysis (CDOT scour measurements, as-built ground elevations, present ground elevations), was available to the research team through CDOT's on-going multi-year Plan of Action (POA) for Scour Critical Bridges study. This data was extracted and compiled from various Hydrau-Tech, Inc., reports and archives, and is provided in the Appendix.

In addition to the sediment size-distribution data at each site collected earlier during the POA study, the Appendix also provides results of numerous new sediment size-gradation analyses conducted to determine the coarse fractions in different streams. Coarse-material size (D_{cfm}) information was collected by:

- Individually collecting larger particles along river reaches (approximately 40-50 large particles along a 100-foot section) immediately upstream from bridges and at approach sections to bridges, and conducting a size analysis to determine an average coarse-material size at each site;
- Taking photographs of river beds at the approach sections with marked targets, and conducting photogrammetric size analysis using FHWA's size-analysis software; and
- In cases where coarse fractions could not be readily identified or measured, using the size-gradation analysis from the earlier POA study.

For the comparative analysis, several methods were used to determine scour at each pier:

- If available, CDOT measurements through the life of the bridge were used to determine changes at each pier. In following this procedure, it was noted that general scour taking place along the river is included in the overall-scour measurement.
- Comparing as-built drawings showing the ground elevation with Hydrau-Tech's recent ground-elevation measurements immediately upstream from the piers to determine pier scour; and
- Using maintenance records and bridge-detail drawings to determine ground elevations, and comparing maintenance records with Hydrau-Tech's ground measurements.

Depending on the quality and frequency of maintenance-record data, results from different methodologies were analyzed and the most-accurate representation was chosen.

Tables 9-12 present the hydraulic, sediment, and pier-scour data used in the computations, as well as results of pier-scour calculations. Table 12 summarizes the computation results and provides measured-scour values derived from CDOT archives, CDOT maintenance, and Hydrau-Tech's field hydraulic surveys and corresponding computed pier-scour values. Figure 5.1 displays computed values against measured scour.

Table 9. Summary of Hydraulic Parameters

Structure ID	Pier	Hydraulics (100 yr)		
		S_E (ft/ft)	V_A (ft/s)	Y_A (ft)
C-09-AR	2	0.0041	5.7	6.8
	3	0.0041	3.6	2.0
E-10-A	2	0.0009	9.4	17.3
	3	0.0009	8.6	7.4
	4	0.0009	6.1	5.6
F-06-M	2	0.0054	14.7	14.200
	3	0.0054	14.6	11.600
H-02-S	2	0.0011	1.9	3.3
	3	0.0011	2.6	6.9
	4	0.0011	2.1	5.2
	5	0.0011	2.7	8.2
	6	0.0011	3.6	10.1
	7	0.0011	13.2	21.8
	8	0.0011	13.1	22.1
	9	0.0011	13.2	19.9
H-04-G	2	0.0300	2.4	2.5
H-04-S	2	0.0055	8.8	6.1
H-04-Z	2	0.0023	10.0	8.3
H-07-H	2	0.0035	3.8	2.5
	3	0.0035	3.3	2.0
H-11-AA	2	0.0030	3.6	2.9
	3	0.0030	3.9	2.1
	4	0.0030	5.9	3.6
	5	0.0030	6.1	2.8
	6	0.0030	1.3	0.5
H-11-U	2	0.0016	3.6	2.5
	3	0.0016	7.3	5.4
I-06-C	2	0.0029	12.2	11.3
	3	0.0029	9.8	6.6
J-01-C	2	0.0022	12.7	9.3
	3	0.0022	12.7	9.6
	4	0.0022	3.1	3.3
J-01-D	2	0.0064	6.7	7.1
J-09-AB	2	0.0054	10.5	6.5
	3	0.0054	11.8	9.5
K-08-D	2	0.0007	6.3	5.2
	3	0.0007	6.7	5.3
L-07-A	2	0.0039	10.2	6.5
	3	0.0039	8.6	4.7

Table 10. Summary of Sediment-Size Properties

Bed Material (ft)			Coarse-Fraction Properties (ft)								
D_{35}	D_{50}	D_{65}	D_{16}	D_{35}	D_{50}	D_{65}	D_{90}	D_{95}	D_{99}	D_{cfm}	D_{cfm}
0.004	0.006	0.018	0.142	0.176	0.198	0.364	0.389	0.426	0.480	0.198	0.198
0.004	0.006	0.018	0.142	0.176	0.198	0.364	0.389	0.426	0.480	0.198	0.198
0.030	0.059	0.082	0.196	0.360	0.475	0.600	0.747	0.810	0.882	0.475	0.475
0.013	0.023	0.049	0.196	0.360	0.475	0.600	0.747	0.810	0.882	0.475	0.475
0.013	0.023	0.049	0.196	0.360	0.475	0.600	0.747	0.810	0.882	0.475	0.475
0.005	0.021	0.056	0.288	0.414	0.500	0.800	0.900	1.000	1.800	0.500	0.500
0.005	0.021	0.056	0.288	0.414	0.500	0.800	0.900	1.000	1.800	0.500	0.500
0.002	0.059	0.075	0.205	0.235	0.259	0.336	0.350	0.500	0.630	0.259	0.259
0.002	0.059	0.075	0.205	0.235	0.259	0.336	0.350	0.500	0.630	0.259	0.259
0.002	0.059	0.075	0.205	0.235	0.259	0.336	0.350	0.500	0.630	0.259	0.259
0.002	0.059	0.075	0.205	0.235	0.259	0.336	0.350	0.500	0.630	0.259	0.259
0.002	0.059	0.075	0.205	0.235	0.259	0.336	0.350	0.500	0.630	0.259	0.259
0.002	0.059	0.075	0.205	0.235	0.259	0.336	0.350	0.500	0.630	0.259	0.259
0.002	0.059	0.075	0.205	0.235	0.259	0.336	0.350	0.500	0.630	0.259	0.259
0.002	0.059	0.075	0.205	0.235	0.259	0.336	0.350	0.500	0.630	0.259	0.259
0.580	0.767	1.100	0.319	0.580	0.767	1.380	1.470	1.900	2.380	0.767	0.767
0.003	0.008	0.015	0.364	0.500	0.575	1.000	1.230	1.470	1.570	0.575	0.575
0.026	0.059	0.082	0.215	0.365	0.487	1.440	1.750	2.080	2.500	0.487	0.487
0.001	0.001	0.015	0.404	0.600	0.670	1.110	1.240	1.370	1.470	0.670	0.670
0.001	0.001	0.015	0.404	0.600	0.670	1.110	1.240	1.370	1.470	0.670	0.670
0.018	0.043	0.082	0.145	0.216	0.313	0.559	0.591	0.657	0.854	0.313	0.313
0.018	0.043	0.082	0.145	0.216	0.313	0.559	0.591	0.657	0.854	0.313	0.313
0.018	0.043	0.082	0.145	0.216	0.313	0.559	0.591	0.657	0.854	0.313	0.313
0.018	0.043	0.082	0.145	0.216	0.313	0.559	0.591	0.657	0.854	0.313	0.313
0.018	0.043	0.082	0.145	0.216	0.313	0.559	0.591	0.657	0.854	0.313	0.313
0.013	0.039	0.072	0.322	0.400	0.458	0.627	0.640	0.720	0.861	0.458	0.458
0.013	0.039	0.072	0.322	0.400	0.458	0.627	0.640	0.720	0.861	0.458	0.458
0.167	0.250	0.333	0.401	0.446	0.482	0.800	1.040	1.170	1.270	0.482	0.482
0.167	0.250	0.333	0.401	0.446	0.482	0.800	1.040	1.170	1.270	0.482	0.482
0.015	0.049	0.082	0.313	0.365	0.410	0.582	0.615	0.680	0.873	0.410	0.410
0.015	0.049	0.082	0.313	0.365	0.410	0.582	0.615	0.680	0.873	0.410	0.410
0.015	0.049	0.082	0.313	0.365	0.410	0.582	0.615	0.680	0.873	0.410	0.410
0.009	0.020	0.043	0.144	0.217	0.308	0.635	0.663	0.845	1.312	0.308	0.308
0.002	0.006	0.012	0.257	0.325	0.379	0.605	0.675	0.775	0.875	0.379	0.379
0.002	0.006	0.012	0.257	0.325	0.379	0.605	0.675	0.775	0.875	0.379	0.379
0.023	0.039	0.049	0.127	0.210	0.300	0.465	0.485	0.560	0.592	0.300	0.300
0.023	0.039	0.049	0.127	0.210	0.300	0.465	0.485	0.560	0.592	0.300	0.300
0.001	0.002	0.003	0.142	0.313	0.367	0.773	0.840	0.920	0.984	0.367	0.367
0.001	0.002	0.003	0.142	0.313	0.367	0.773	0.840	0.920	0.984	0.367	0.367

Table11. Summary of Computed Pier-Scour Parameters

Structure	V_i (ft/s)	V_c (ft/s)	ψ	K_i	K_4	*b* (ft)
C-09-AR	1.07	9.63	0.54	0.91	1.00	1.50
C-09-AR	0.87	7.85	0.39	0.88	1.00	1.50
E-10-A	2.39	15.06	0.55	0.88	1.00	2.50
E-10-A	1.58	13.07	0.61	0.91	1.00	2.50
E-10-A	1.51	12.48	0.42	0.88	1.00	2.50
F-06-M	1.24	14.821	0.991	0.961	1.000	3.500
F-06-M	1.20	14.330	1.000	0.962	1.000	3.500
H-02-S	0.69	9.35	0.14	0.82	0.89	2.30
H-02-S	0.78	10.56	0.19	0.85	0.89	2.20
H-02-S	0.75	10.08	0.14	0.82	0.89	2.20
H-02-S	0.80	10.86	0.19	0.85	0.89	2.30
H-02-S	0.83	11.25	0.27	0.89	0.93	2.50
H-02-S	0.95	12.78	1.00	0.97	1.00	2.80
H-02-S	0.95	12.81	1.00	0.97	1.00	2.80
H-02-S	0.93	12.60	1.00	0.97	1.00	2.80
H-04-G	4.67	12.81	0.00	0.00	1.00	1.00
H-04-S	0.89	13.49	0.63	0.95	1.00	3.00
H-04-Z	2.03	13.43	0.70	0.90	1.00	1.50
H-07-H	0.49	12.23	0.28	0.94	0.98	4.00
H-07-H	0.47	11.79	0.25	0.93	0.96	4.00
H-11-AA	1.50	9.73	0.25	0.78	0.97	1.00
H-11-AA	1.43	9.25	0.32	0.81	1.00	1.00
H-11-AA	1.56	10.09	0.51	0.87	1.00	1.00
H-11-AA	1.49	9.67	0.56	0.88	1.00	1.00
H-11-AA	1.12	7.26	0.03	0.41	1.00	1.00
H-11-U	1.32	10.78	0.24	0.81	0.92	1.00
H-11-U	1.50	12.25	0.54	0.90	1.00	1.00
I-06-C	3.96	14.09	0.81	0.84	1.00	7.00
I-06-C	3.62	12.90	0.67	0.81	1.00	7.00
J-01-C	1.71	12.93	0.98	0.94	1.00	2.00
J-01-C	1.72	13.00	0.97	0.94	1.00	2.00
J-01-C	1.44	10.88	0.18	0.76	0.90	2.00
J-01-D	1.38	11.22	0.54	0.90	1.00	1.30
J-09-AB	0.84	11.86	0.88	0.96	1.00	2.00
J-09-AB	0.90	12.64	0.93	0.96	1.00	2.00
K-08-D	1.80	10.57	0.51	0.86	1.00	2.00
K-08-D	1.80	10.61	0.56	0.87	1.00	2.00
L-07-A	0.73	11.74	0.86	0.97	1.00	2.00
L-07-A	0.69	11.12	0.76	0.96	1.00	2.00

Table 12. Summary of Computed Pier-Scour and Measured Scour

Pier ID	Measured Scour Y_{sm} (ft)	Computed Scour Y_{sc} (ft)
C-09-AR2	0.00	2.58
C-09-AR3	2.00	1.75
E-10-A2	5.41	4.29
E-10-A3	5.41	3.92
E-10-A4	1.60	3.04
F-06-M2	5.79	7.14
F-06-M3	5.14	6.94
H-02-S2	1.07	1.46
H-02-S3	1.14	1.88
H-02-S4	2.09	1.52
H-02-S5	5.08	1.97
H-02-S6	6.53	2.62
H-02-S7	7.20	6.66
H-02-S8	6.20	6.68
H-02-S9	4.50	6.56
H-04-G2	2.90	0.00
H-04-S2	5.50	4.35
H-04-Z2	3.20	3.08
H-07-H2	0.80	2.91
H-07-H3	0.00	2.62
H-11-AA2	3.70	1.13
H-11-AA3	2.90	1.21
H-11-AA4	2.80	1.72
H-11-AA5	3.50	1.73
H-11-AA6	3.40	0.25
H-11-U2	0.00	1.07
H-11-U3	0.00	1.90
I-06-C2	13.90	9.74
I-06-C3	10.55	7.97
J-01-C2	4.50	4.57
J-01-C3	0.00	4.57
J-01-C4	1.70	1.49
J-01-D2	0.84	2.36
J-09-AB2	2.60	4.04
J-09-AB3	0.90	4.45
K-08-D2	1.56	2.90
K-08-D3	0.90	3.04
L-07-A2	3.07	4.00
L-07-A3	2.73	3.53

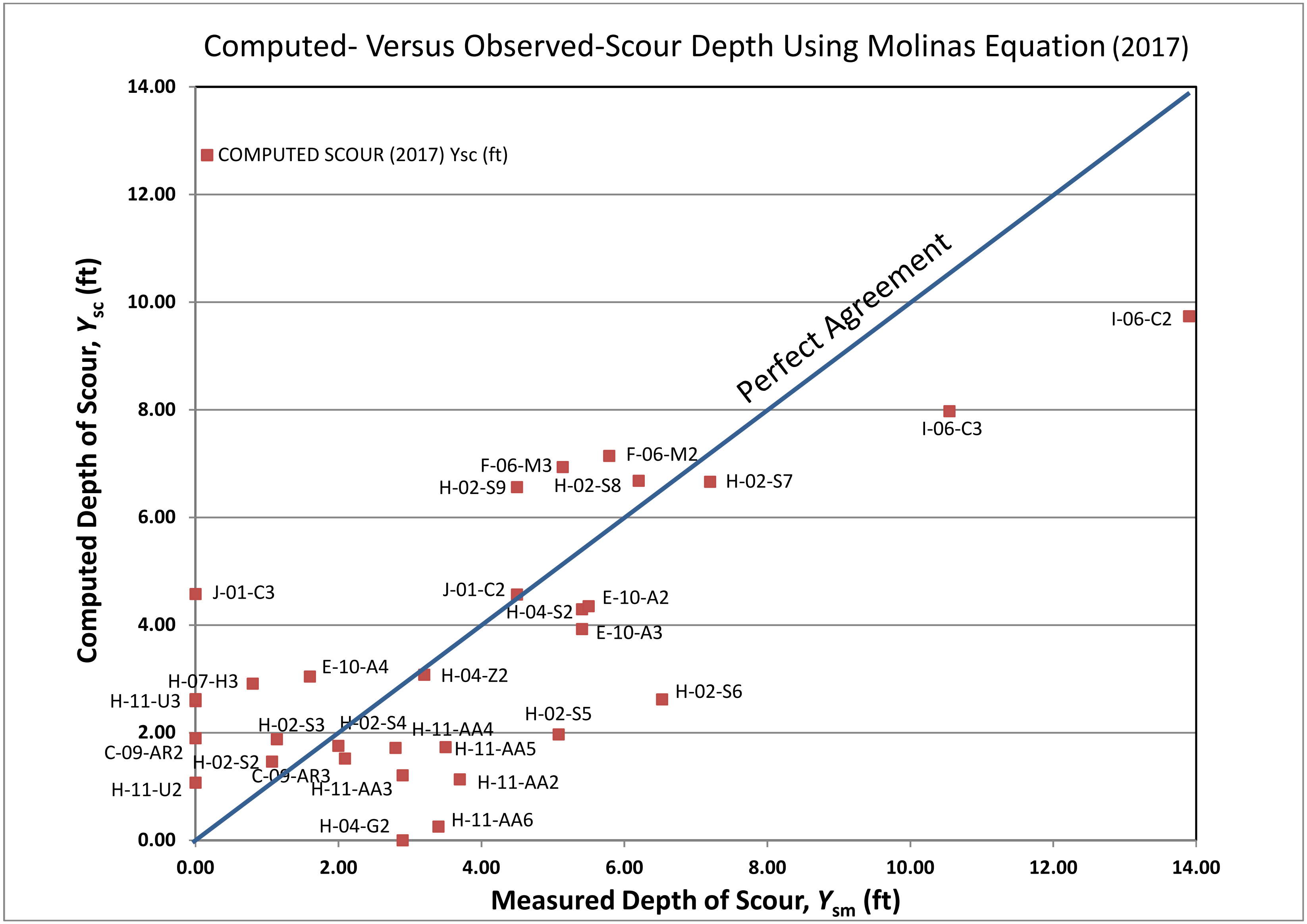


Figure 5.1 Computed Versus Observed Pier Scour at Colorado Streams Using the Newly-Developed Colorado Pier-Scour Equation

6. SUMMARY AND CONCLUSIONS

In this research study, a new bridge pier-scour equation suitable for streams flowing through mountainous regions of Colorado was developed. This equation utilizes the dimensionless excess-velocity concept, and relates this flow parameter to pier scour. Dimensionless excess velocity, by including critical and scour-initiating velocities in its definition, accommodates the presence of cobbles and boulders (through the critical-velocity term), as well as the finer sand-gravel size material (through the scour-initiating velocity term).

The development of the study's various research tasks is presented in Chapter 2. Chapter 3 presents the approach, and Chapter 4 discusses previous work conducted at Colorado State University by Dr. Molinas through a 6-year FHWA study to examine effects of gradation. Theoretical development of the new scour equation and initial steps in its derivation are presented. The general form of the equation leads to calibration coefficients relating critical and scour-initiation velocities to representative fine material (D_{35} of parent-sediment material found on the river bed), and to average coarse material that exists in abundance along mountain streams. Chapter 5 present the new scour equation and applies this equation to compute pier scour at 16 different sites scattered across mountainous parts of CDOT Regions 3 and 5.

Sources of the data used in the analysis are presented in Chapter 5. Extensive data from 16 bridges, a culmination of bridge-scour studies conducted for CDOT by Hydrau-Tech, Inc. for a Plan of Action (POA) for Scour Critical Bridges study is described. Additional coarse-material data collected for this project is described, along with methodologies employed to determine pier-scour estimates. Finally, tables related to scour computations are presented, and computed scour is compared with measured scour.

As shown in Figure 5.1, measured and computed pier-scour values for the 38 piers included in the study show very good agreement through the entire range of observed scour values, which vary from 0 to 14 ft. Considering that the coarse material in the streams varied from 2 in to 24 in, computed velocities ranged from 2 to 15 ft/sec, and the range of parent materials varied from sand and gravel to boulder sizes, it can be concluded that the equation was tested through a wide range of flow and environment conditions and has been shown to be an excellent predictor.

APPENDICES

APPENDIX A – SITE REVIEW AND PHOTOS

APPENDIX B – HYDROLOGIC ANALYSIS

APPENDIX C – CDOT INSPECTION INFORMATION

APPENDIX D – MEASURED PIER-SCOUR METHODOLOGY

APPENDIX E – EXISTING BRIDGE PLANS AND SUBSURFACE INFORMATION

APPENDIX F – HYDRAULIC ANALYSIS

APPENDIX G – SEDIMENT SIZE ANALYSIS

Appendix A – Site Review and Photos

Figure A.1.1. (E-10-A)
Looking toward the structure entrance

Figure A.1.2.
Looking toward the structure outlet

Figure A.1.3.
Looking at the Colorado River upstream from the structure

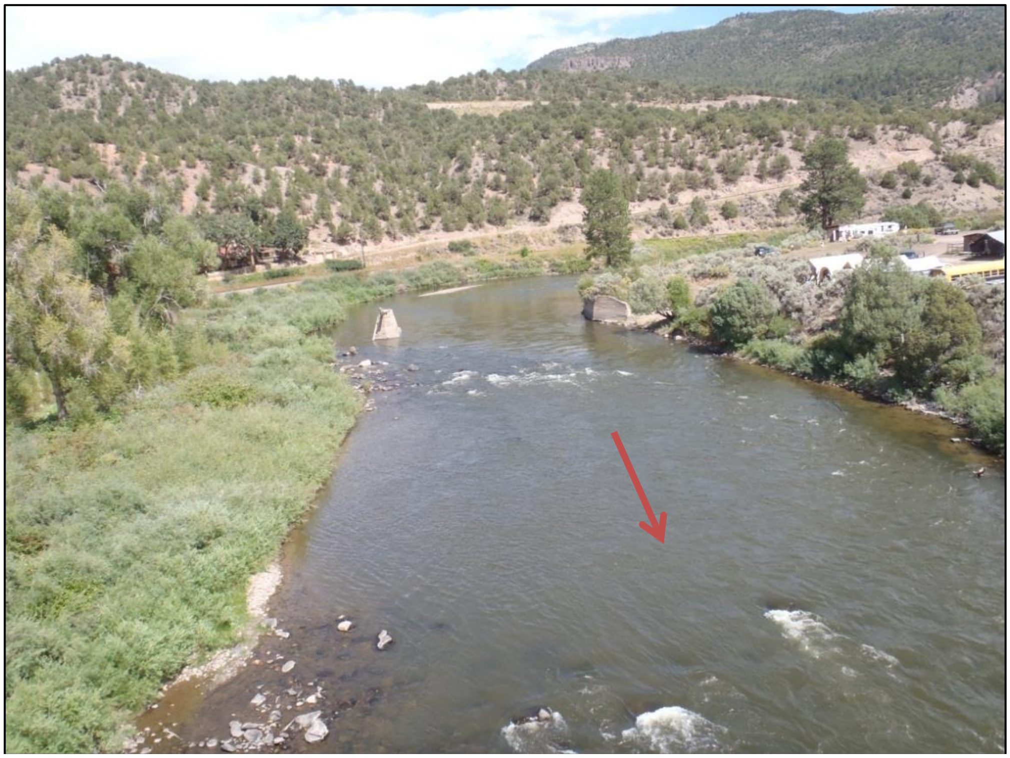


Figure A.1.4.
Looking at the Colorado River downstream from the structure

Figure A.1.5.
Roadway looking toward increasing roadway station

Figure A.1.6.
Roadway looking toward decreasing roadway station

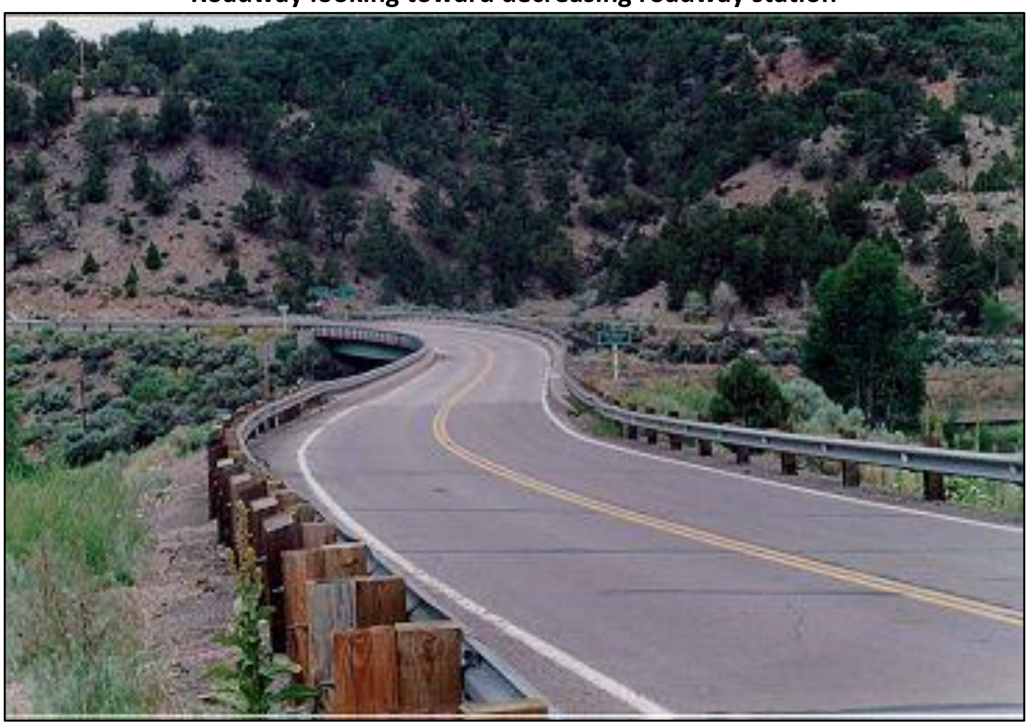


Figure A.1.7.
Looking toward the left abutment

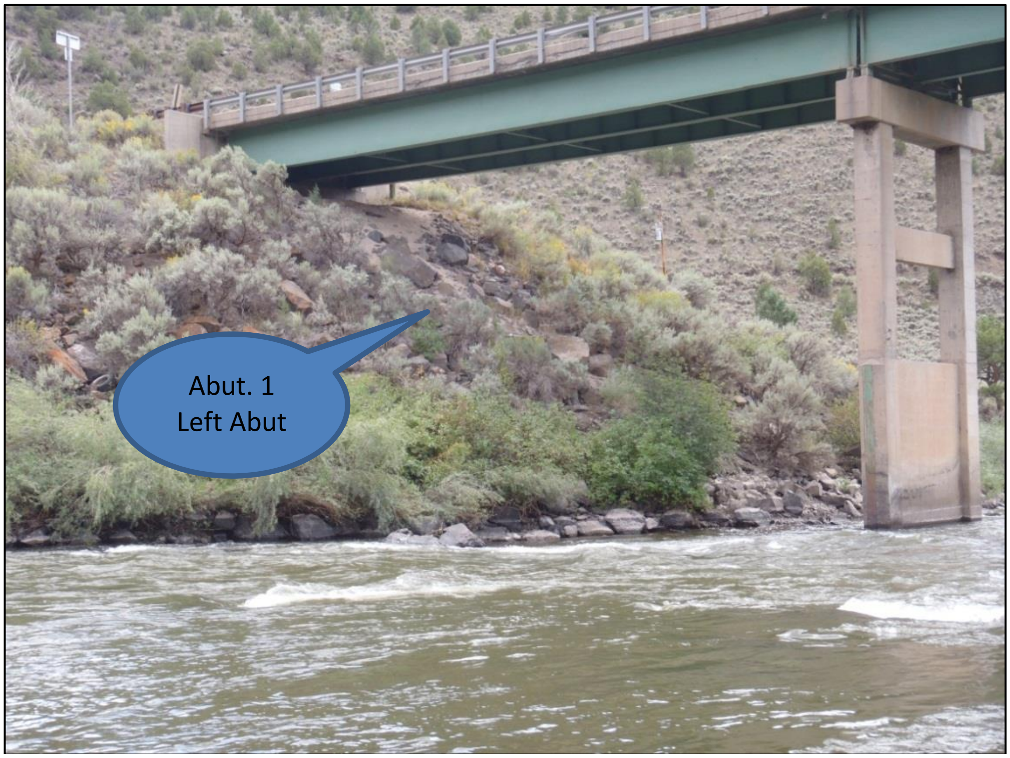


Figure A.1.8
Looking toward the right abutment

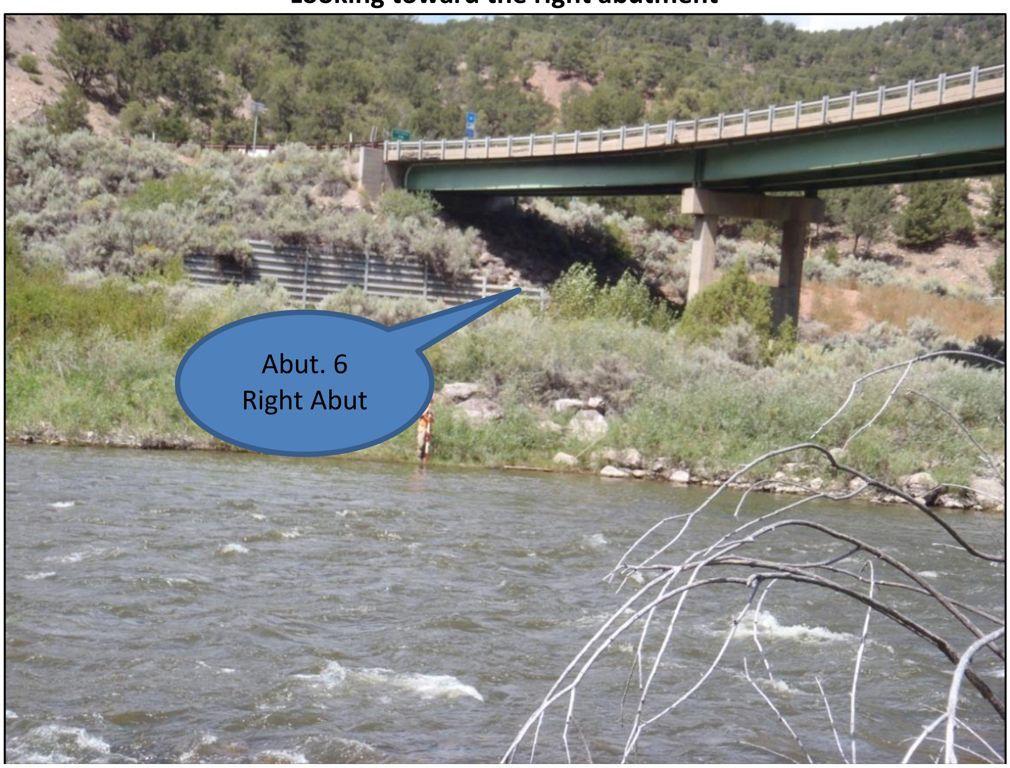


Figure A.2.1. (F-06-M)
Looking toward the structure entrance

Figure A.2.2.
Looking toward the structure outlet

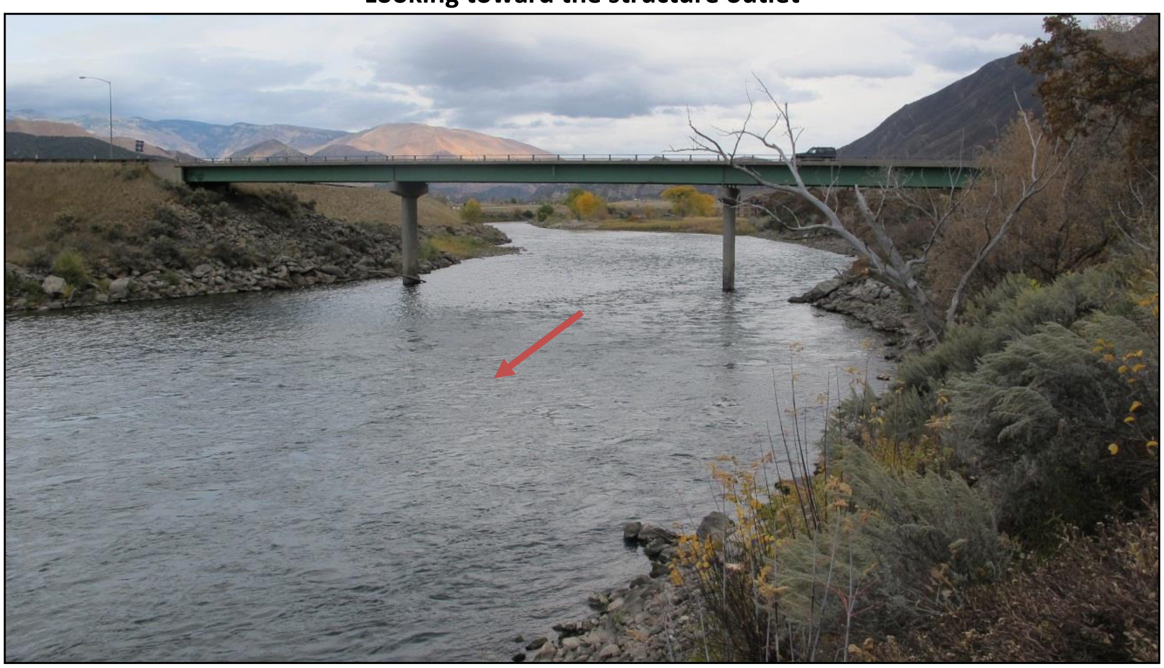


Figure A.2.3.
Looking at the Colorado River upstream from the structure

Figure A.2.4.
Looking at the Colorado River downstream from the structure

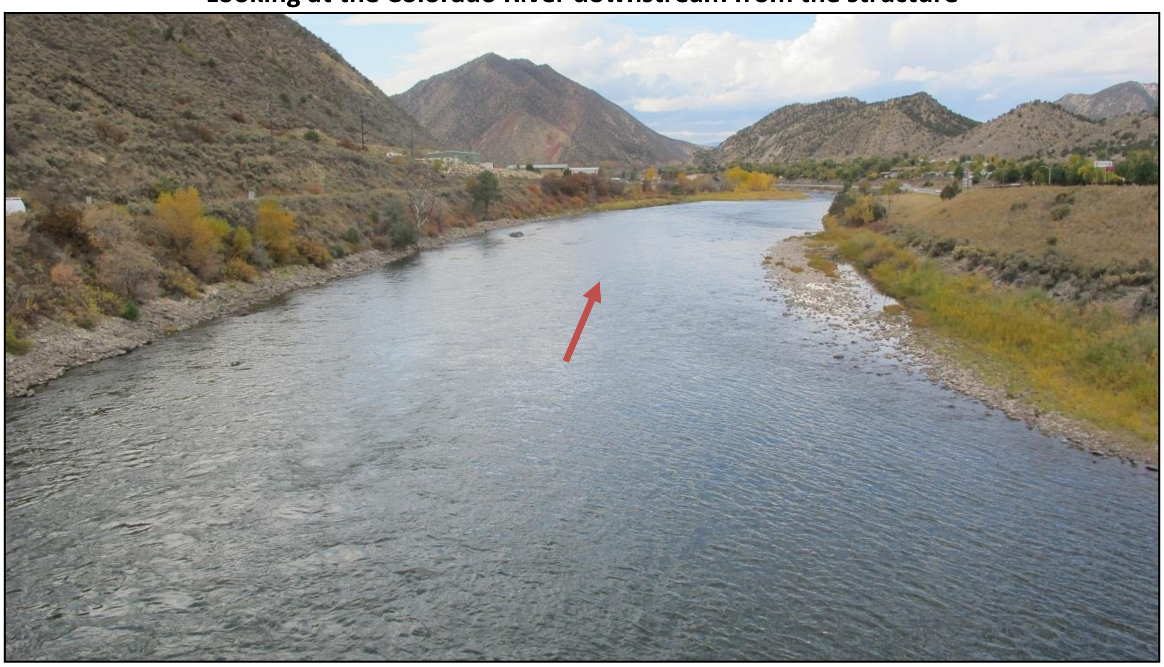


Figure A.2.5.
Roadway looking toward increasing roadway station

Figure A.2.6.
Roadway looking toward decreasing roadway station

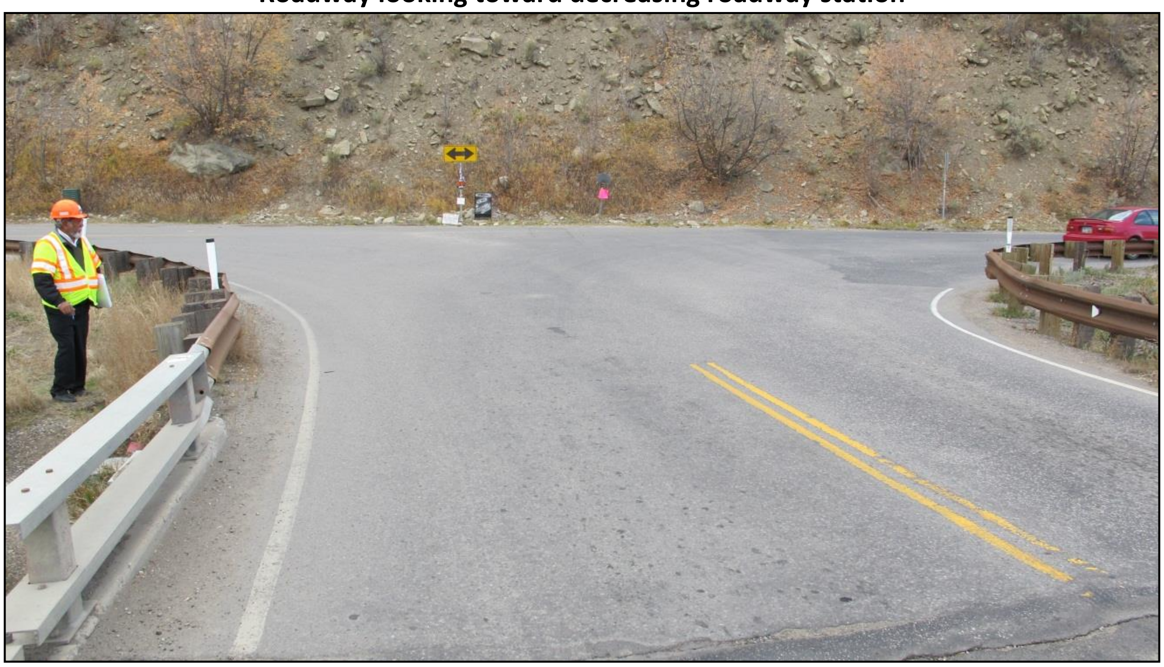


Figure A.2.7.
Looking toward the left abutment

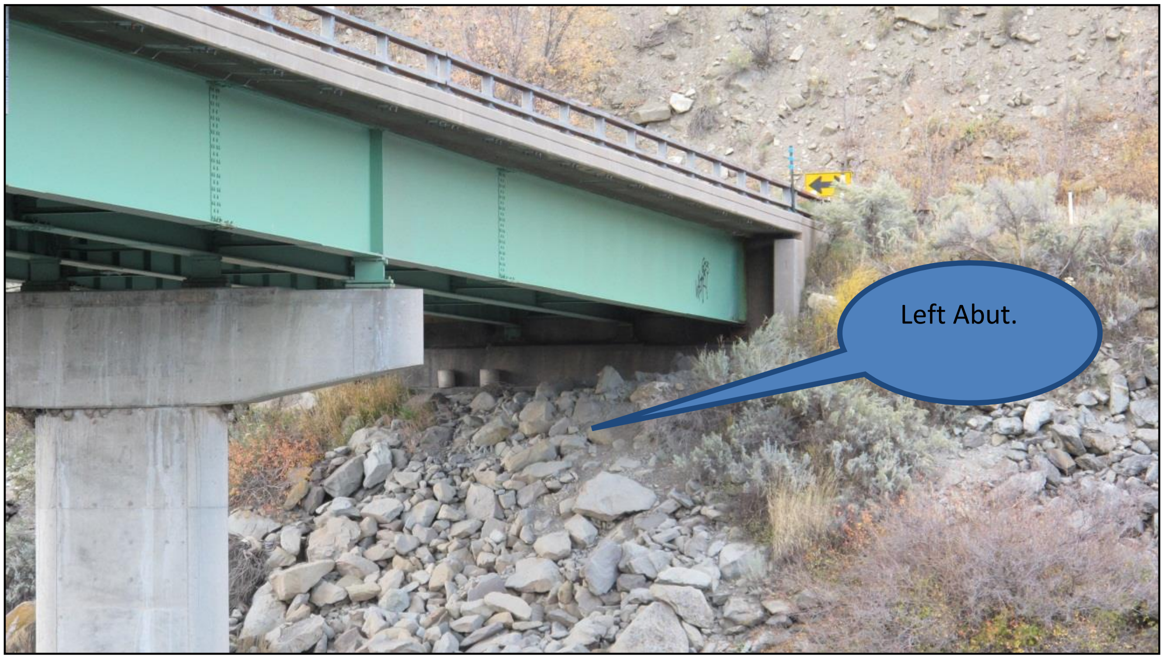


Figure A.2.8.
Looking toward the right abutment

Figure A.3.1. (H-02-S)
Looking toward the structures entrance

Figure A.3.2.
Looking toward the structures outlet

Figure A.3.3.
Looking at the Colorado River upstream from the structures

Figure A.3.4.
Looking at the Colorado River downstream from the structures

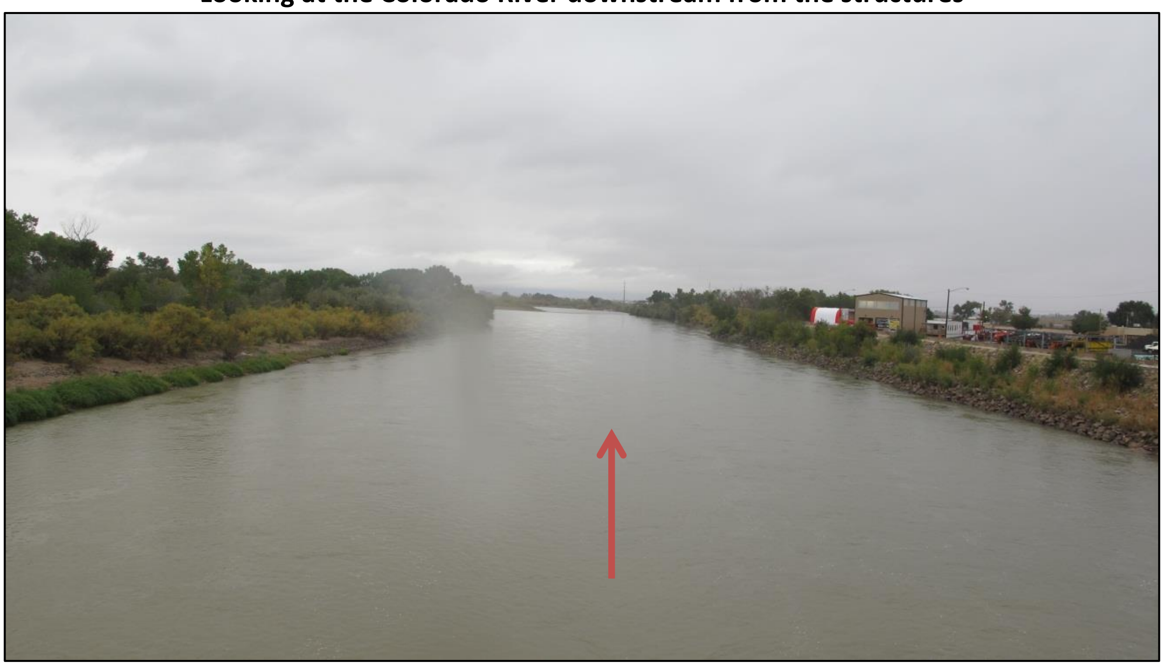


Figure A.3.5.
Roadway looking toward increasing roadway station

Figure A.3.6.
Roadway looking toward decreasing roadway station

Figure A.3.7.
Looking toward the left abutment

Figure A.3.8.
Looking toward the right abutments

Figure A.4.1. (H-04-Z)

Looking toward the structure entrance

Figure A.4.2.
Looking toward the structure outlet

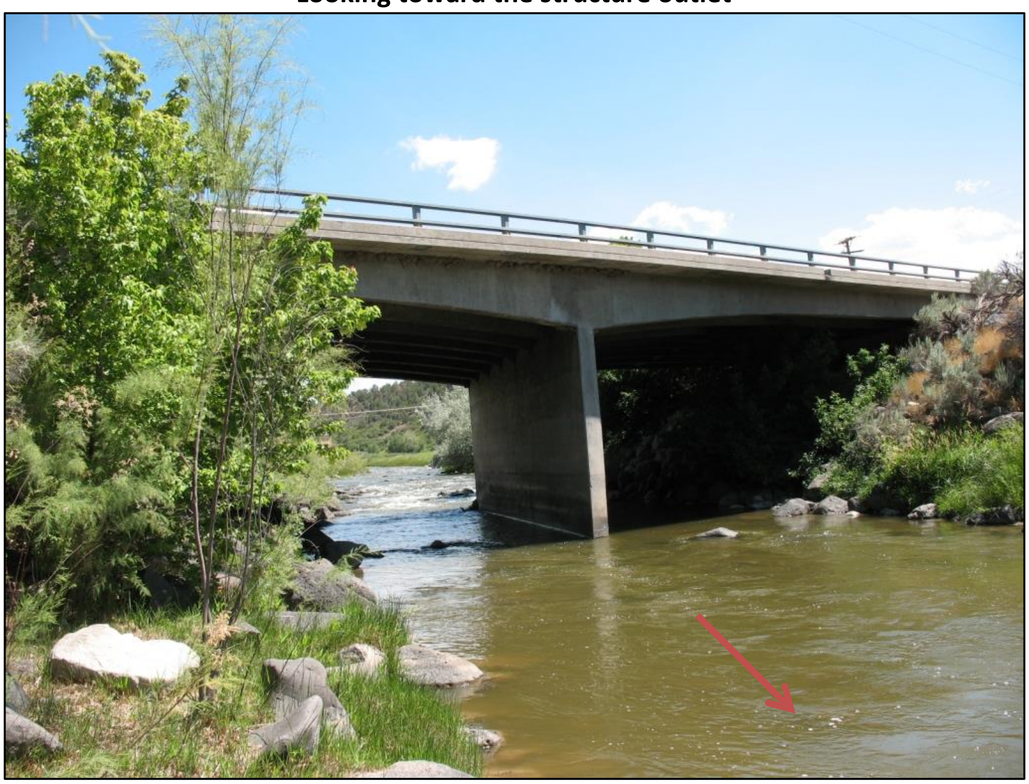


Figure A.4.3.
Looking at Plateau Creek upstream from the structure

Figure A.4.4.
Looking at Plateau Creek downstream from the structure

Figure A.4.5.
Roadway looking toward increasing roadway station

Figure A.4.6.
Roadway looking toward decreasing roadway station

Figure A.4.7.
Looking toward the left abutment

Figure A.4.8.
Looking toward the right abutment

Figure A.5.1. (H-07-H)
Looking toward the structure entrance

Figure A.5.2.
Looking toward the structure outlet

Figure A.5.3.
Looking toward East Muddy Creek upstream from the structure

Figure A.5.4.
Looking toward East Muddy Creek downstream from the structure

Figure A.5.5.
Roadway looking toward increasing roadway station

Figure A.5.6.
Roadway looking toward decreasing roadway station

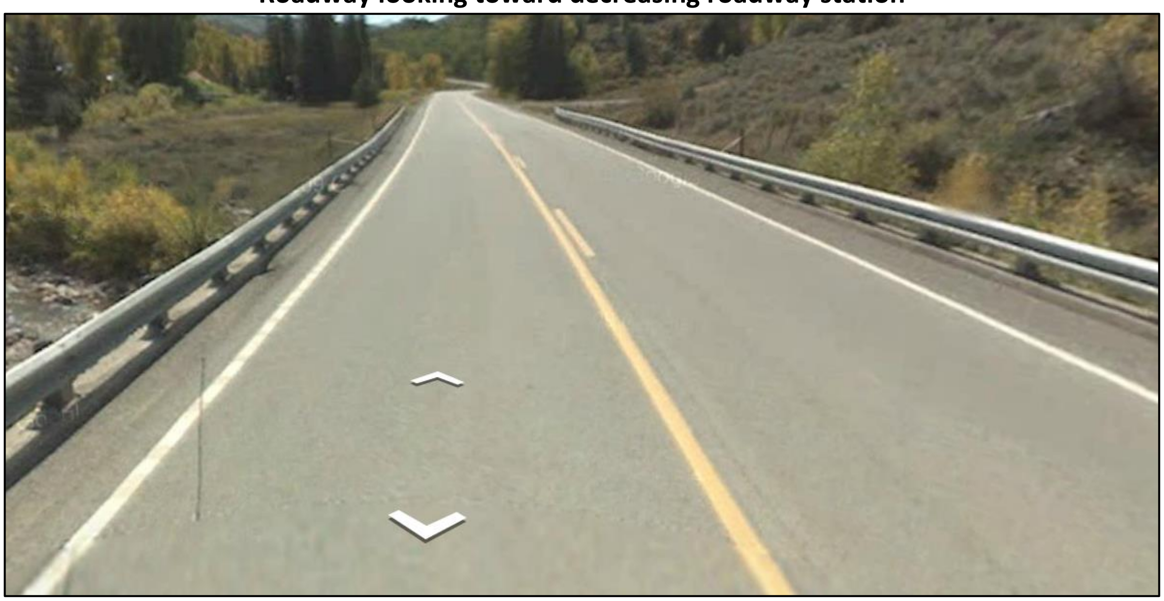


Figure A.5.7.
Looking toward left abutment

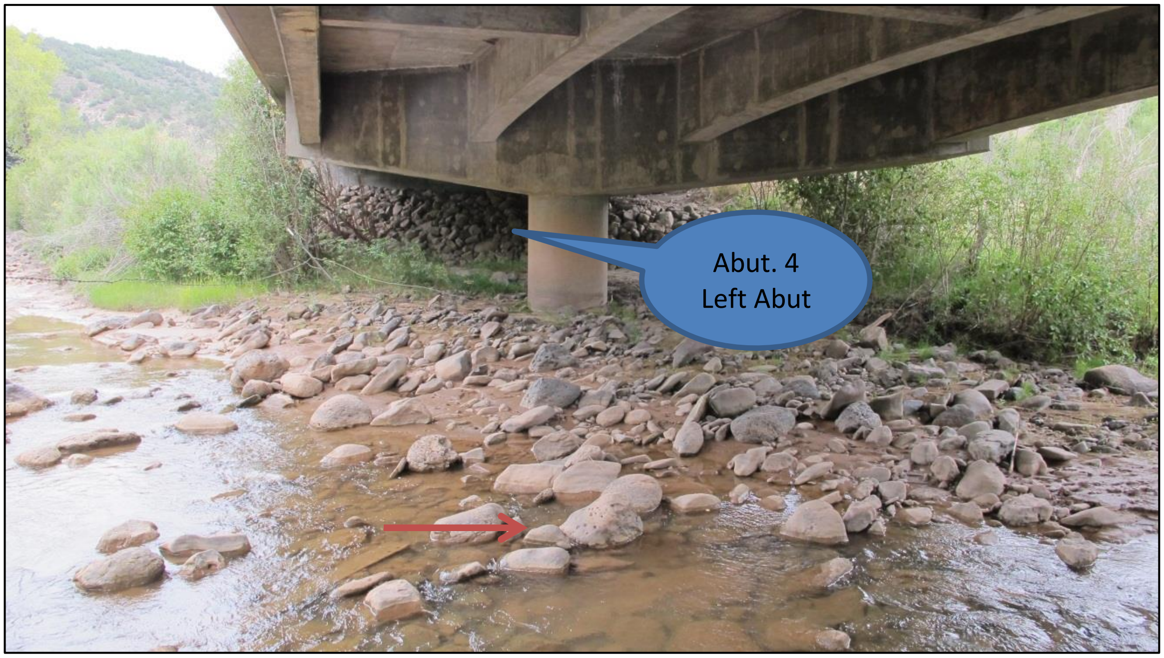


Figure A.5.8.
Looking toward right abutment

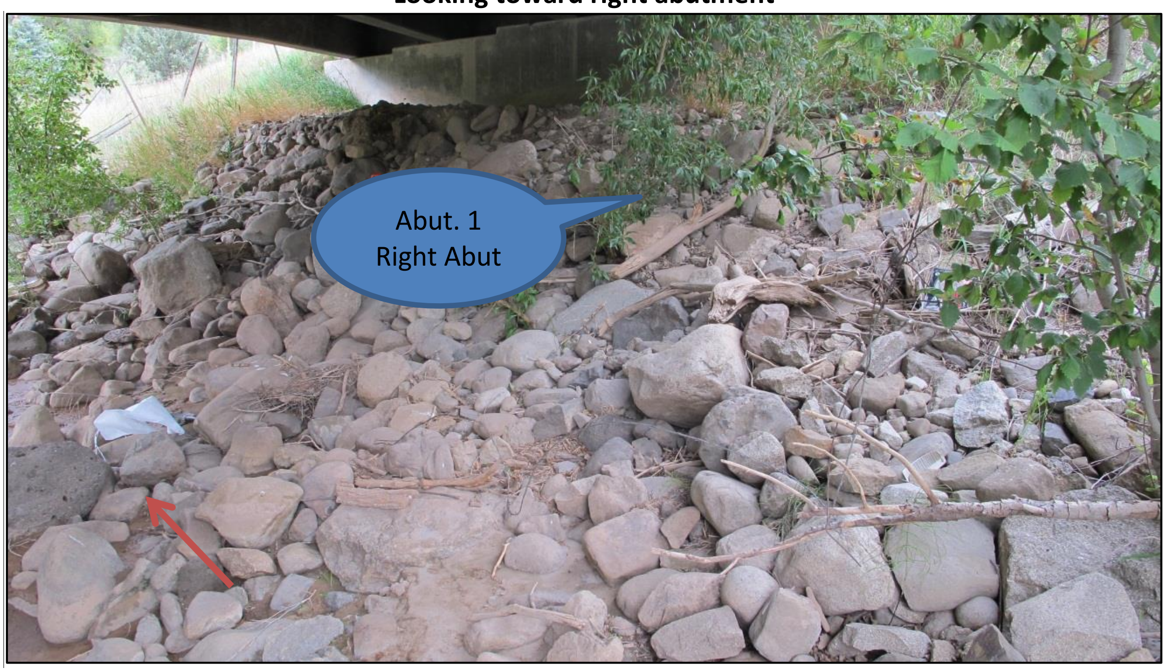


Figure A.6.1. (H-11-AA)
Looking toward the structure entrance

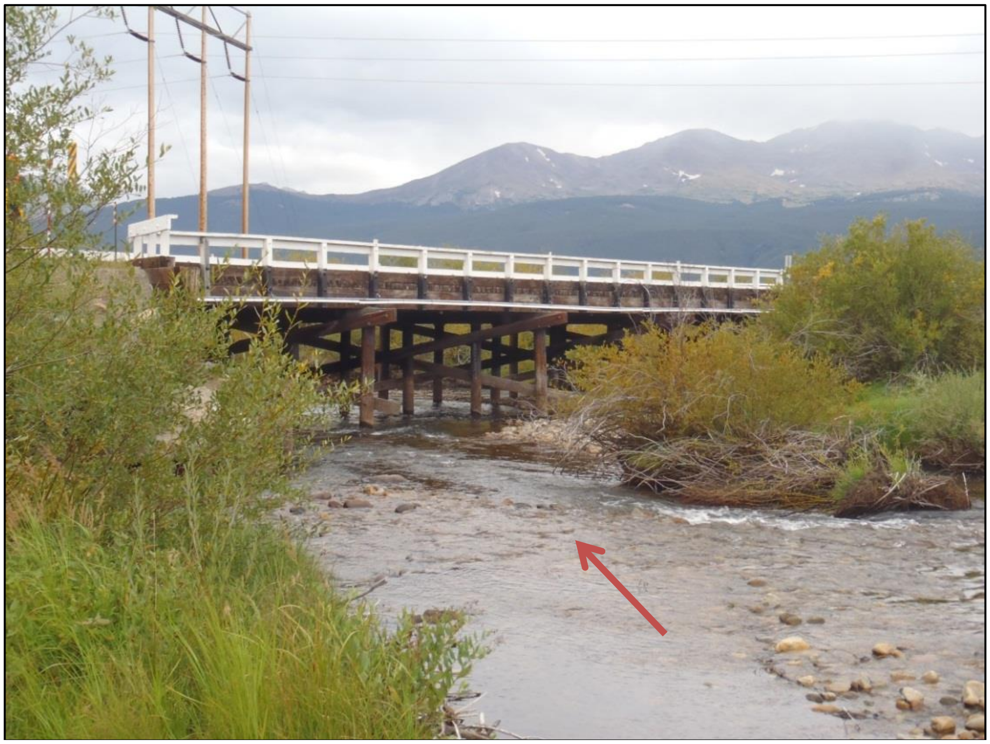


Figure A.6.2.
Looking toward the structure outlet

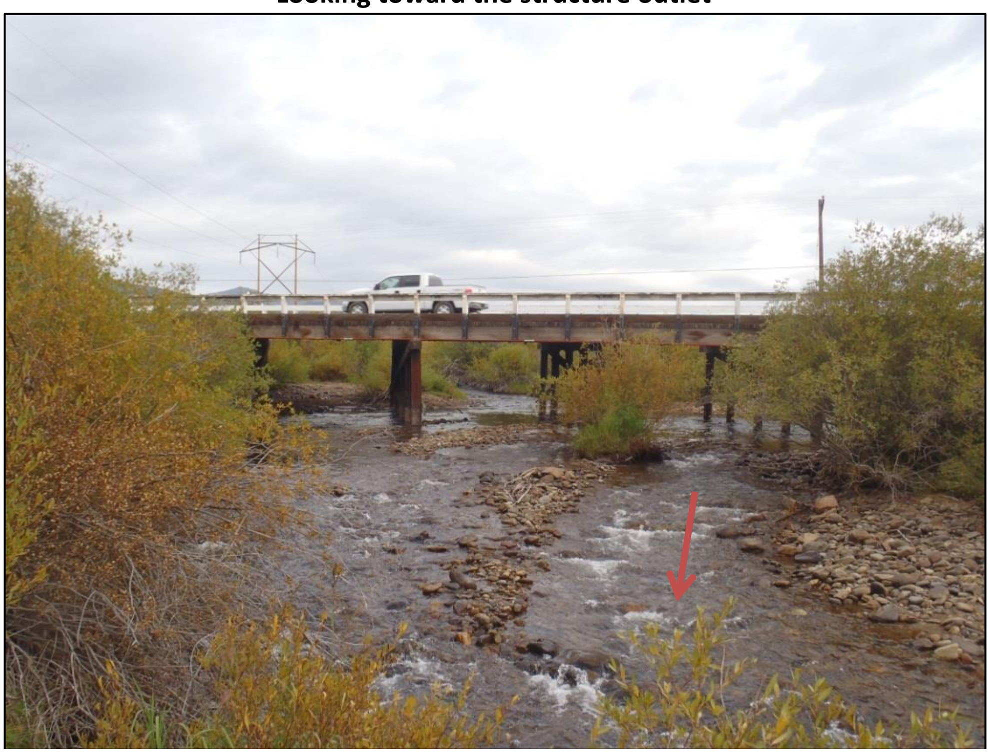


Figure A.6.3.
Looking at the Arkansas River upstream from the structure

Figure A.6.4.
Roadway looking toward increasing roadway station

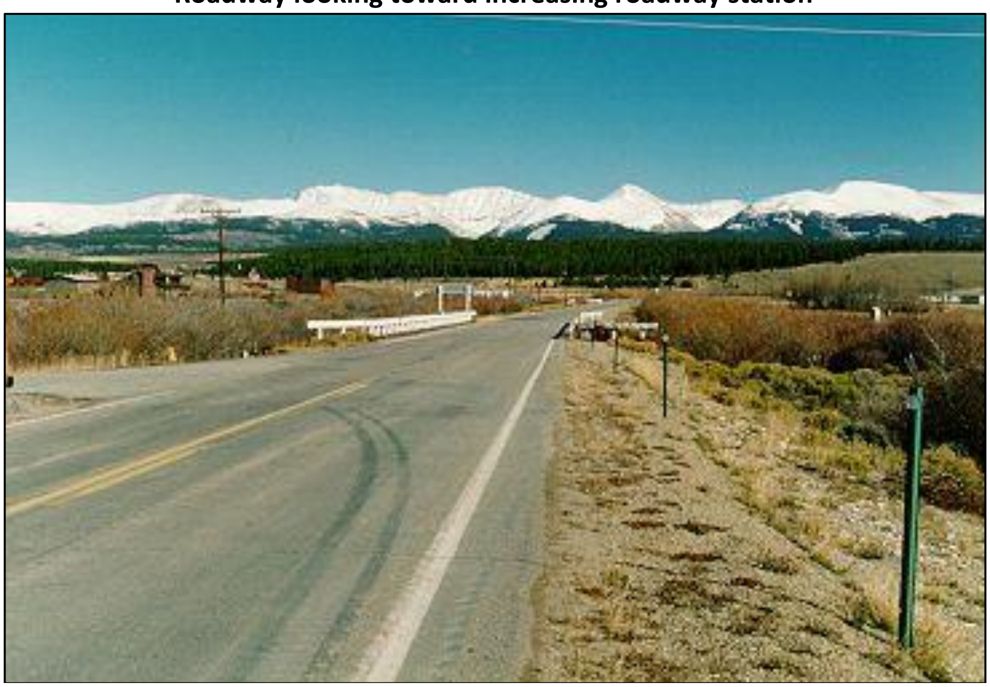


Figure A.6.5.
Roadway looking toward decreasing roadway station

Figure A.6.6.
Looking toward the left abutment

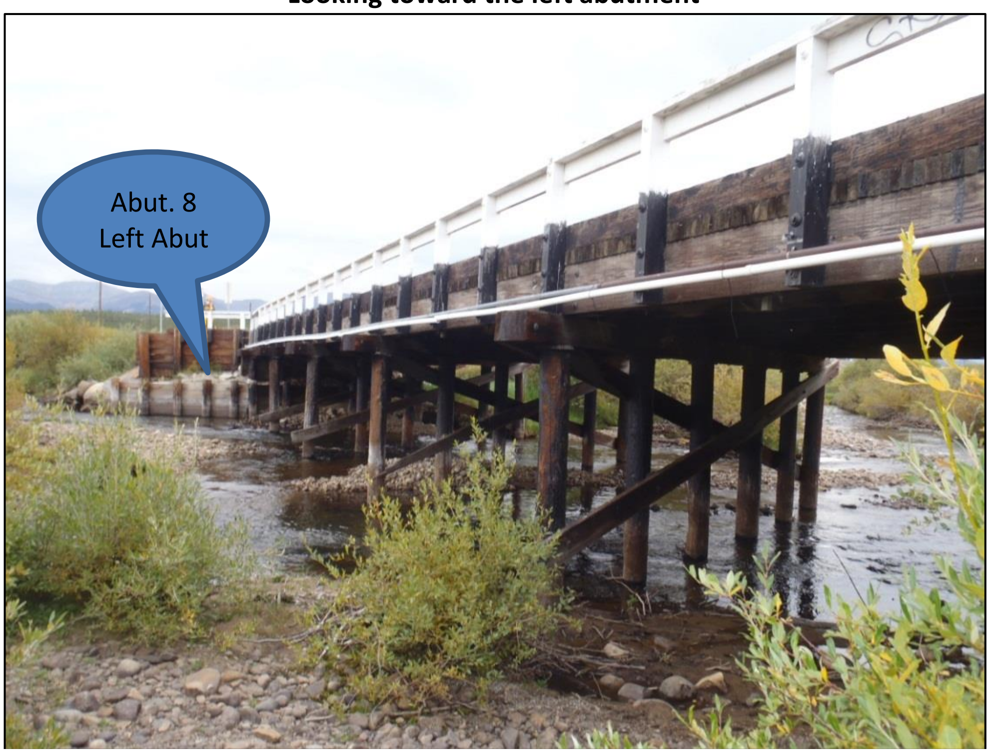


Figure A.6.7.
Looking toward the right abutment

Figure A.7.1. (H-11-U)
Looking toward the structure entrance

Figure A.7.2.
Looking toward the structure outlet

Figure A.7.3.
Looking at the Lake Fork Creek upstream from the structure

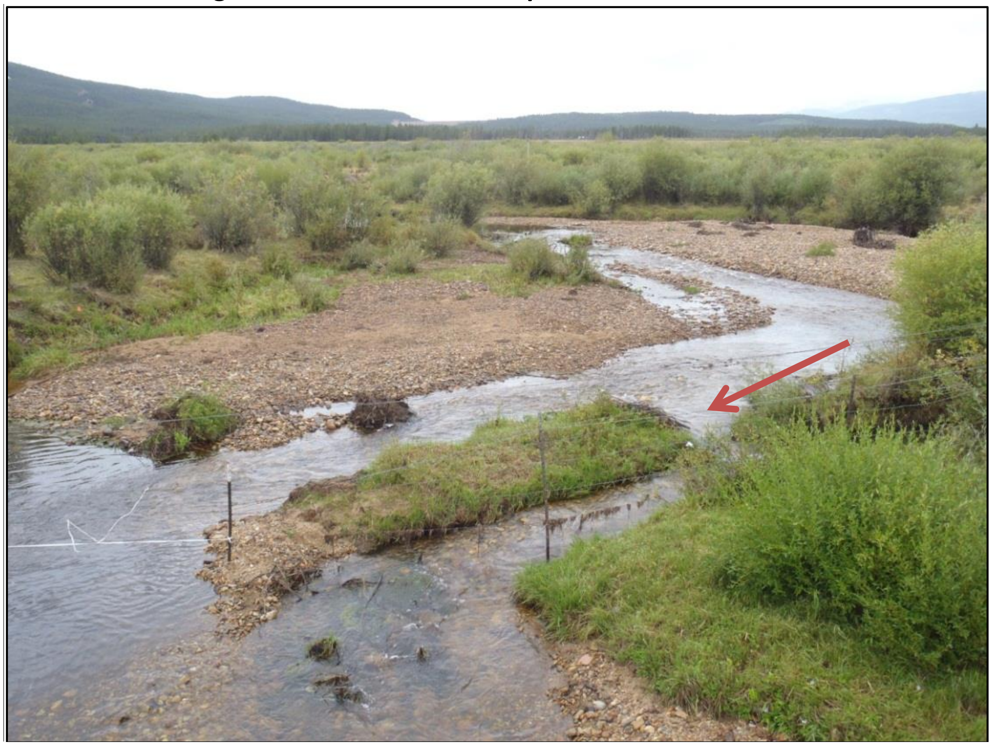


Figure A.7.4.
Looking at the Lake Fork Creek downstream from the structure

Figure A.7.5.
Roadway looking toward increasing roadway station

Figure A.7.6.
Roadway looking toward decreasing roadway station

Figure A.7.7.
Looking toward the left abutment

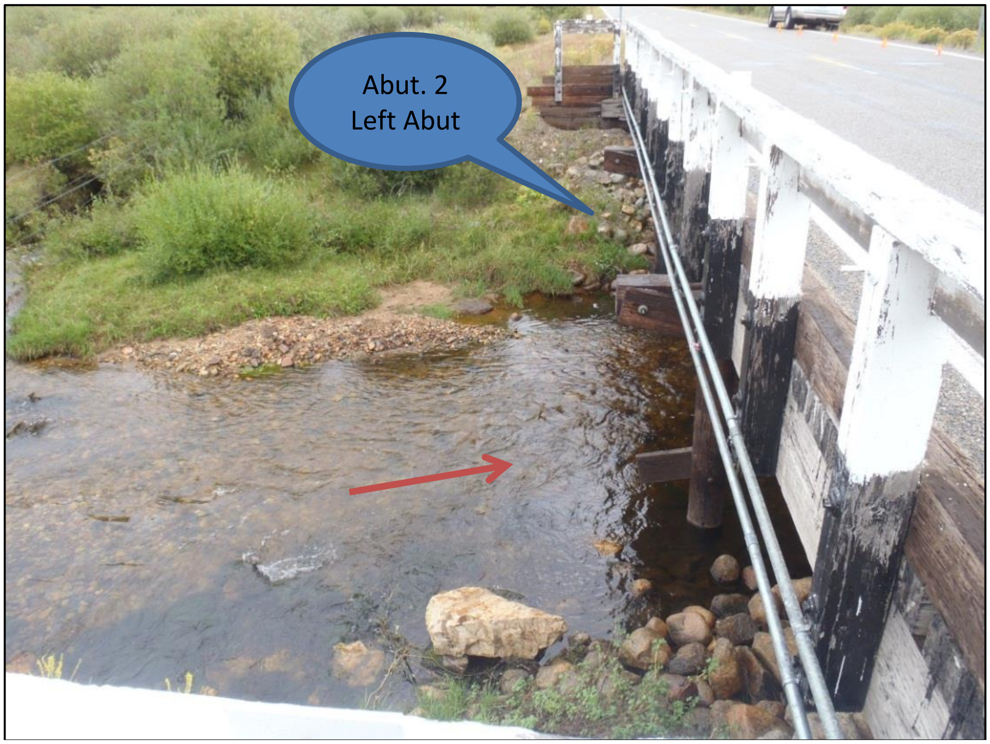


Figure A.7.8.
Looking toward the right abutment

Figure A.8.1. (I-06-C)
Looking toward the structure entrance

Figure A.8.2.
Looking toward the structure outlet

Figure A.8.3.
Looking at the North Fork Gunnison River upstream from of the structure

Figure A.8.4.
Looking at the North Fork Gunnison River downstream from the structure

Figure A.8.5.
Roadway looking toward increasing roadway station

Figure A.8.6.
Roadway looking toward decreasing roadway station

Figure A.8.7.
Looking toward the left abutment

Figure A.8.8.
Looking toward the right abutment

Figure A.9.1. (J-01-C)
Looking toward the structure entrance

Figure A.9.2.
Looking toward the structure outlet

Figure A.9.3.
Looking at Dolores River upstream from the structure

Figure A.9.4.
Looking at Dolores River downstream from the structure

Figure A.9.5.
Roadway looking toward increasing roadway station

Figure A.9.6.
Roadway looking toward decreasing roadway station

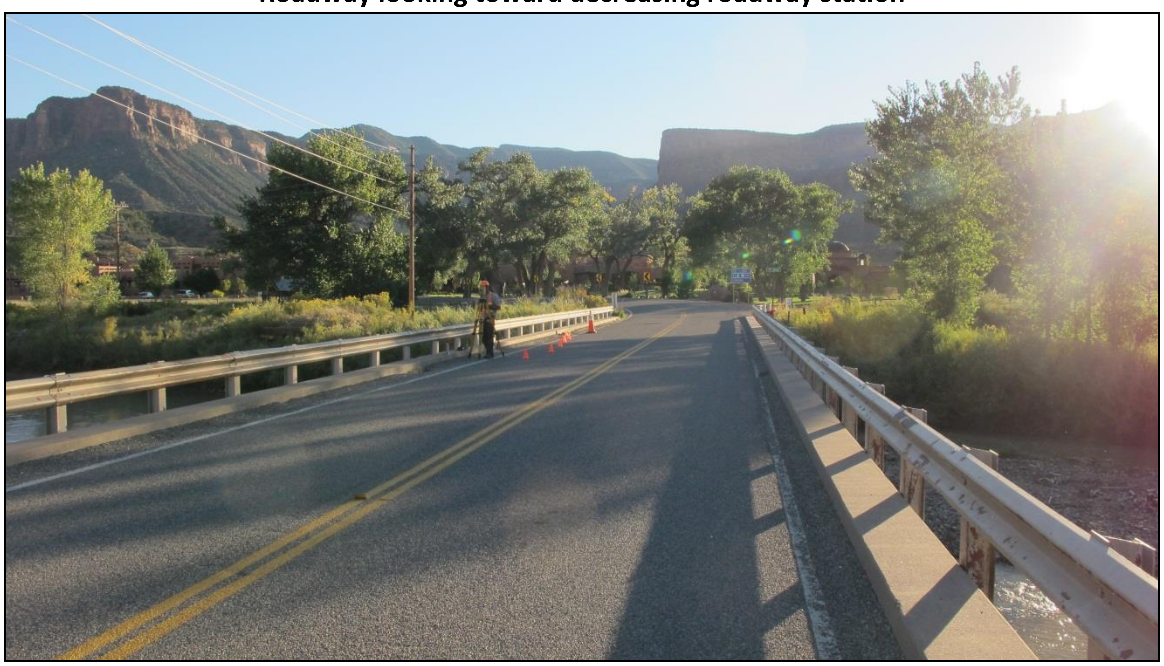


Figure A.9.7.
Looking toward left abutment

Figure A.9.8.
Looking toward right abutment

Figure A.10.1. (J-01-D)
Looking toward the structure entrance

Figure A.10.2.
Looking toward the structure outlet

Figure A.10.3.
Looking at John Brown Creek upstream from the structure

Figure A.10.4.
Looking at John Brown Creek downstream from the structure

Figure A.10.5.
Roadway looking toward increasing roadway station

Figure A.10.6.
Roadway looking toward decreasing roadway station

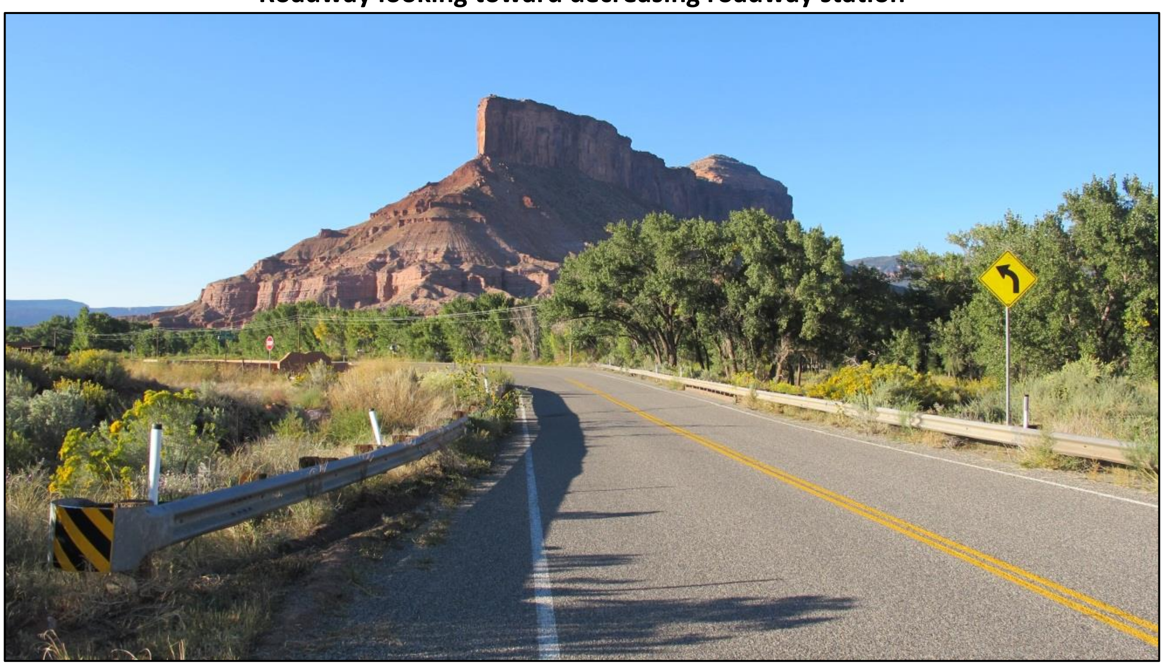


Figure A.10.7.
Looking toward left abutment

Figure A.10.8.
Looking toward right abutment

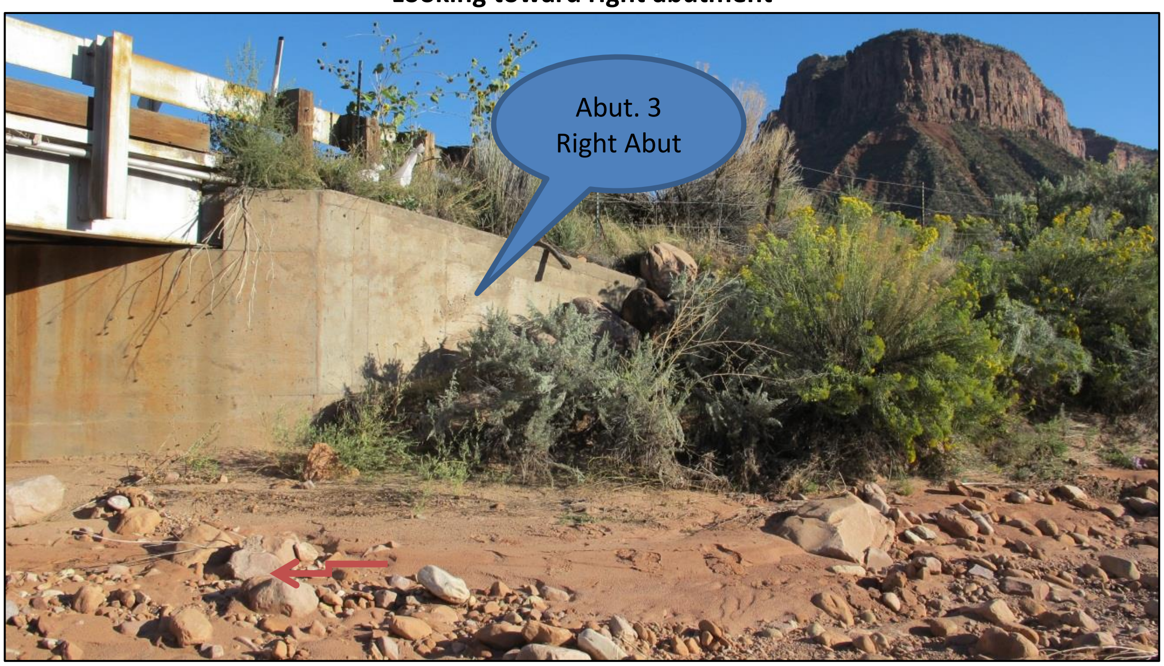


Figure A.11.1. (J-09-AB)
Looking toward the downstream face of the structure

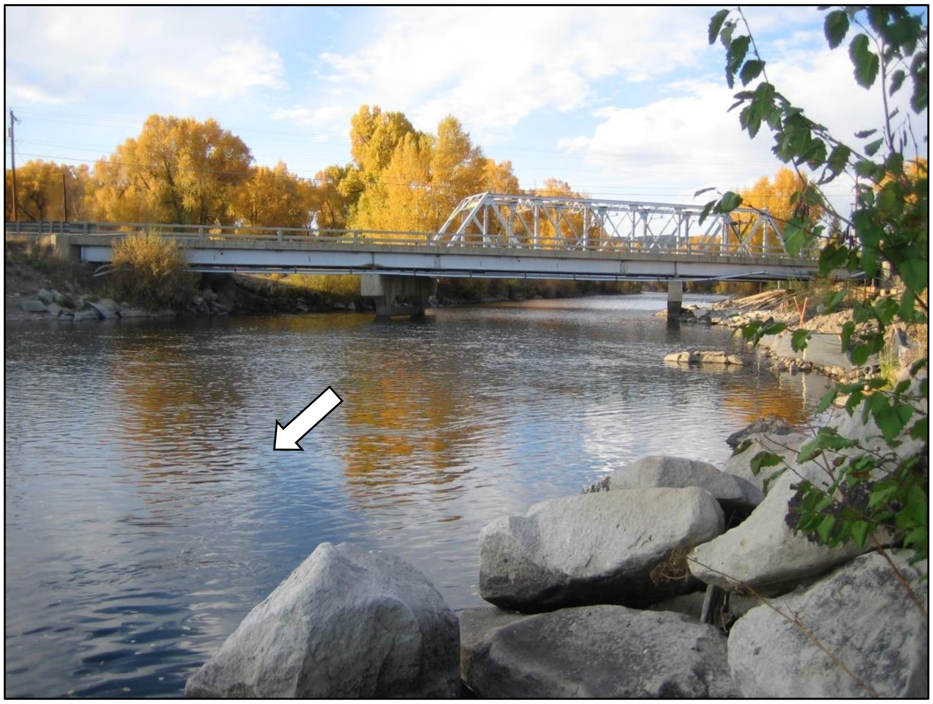


Figure A.11.2.
Looking at the Gunnison River upstream from the structure

Figure A.11.3.
Looking upstream towards the left pier and embankment of J-09-AB

Figure A.11.4.
Looking towards the right abutment

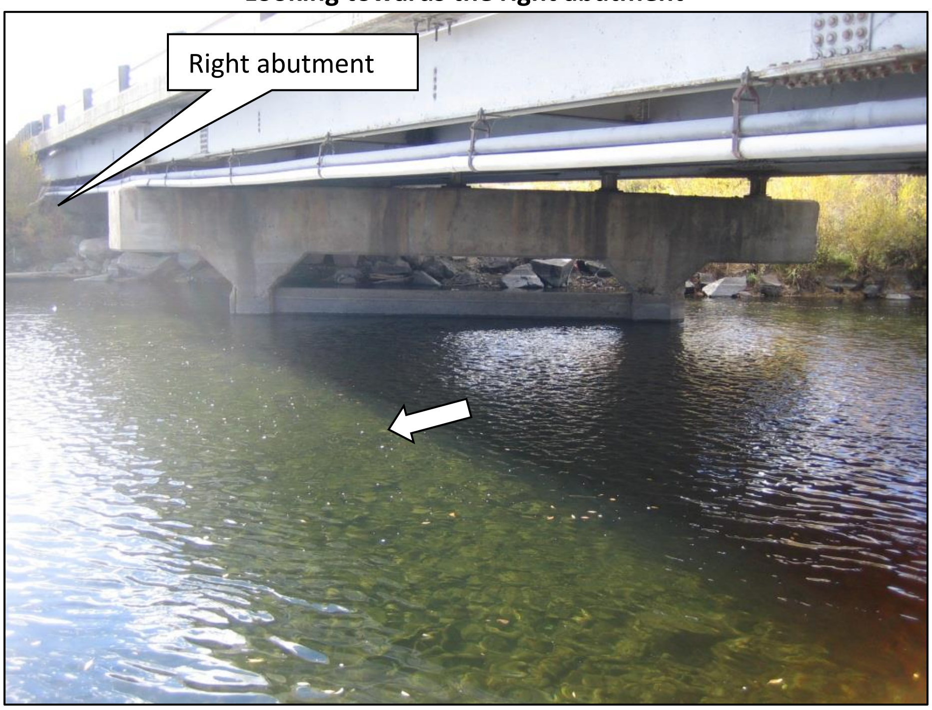


Figure A.11.5.
Looking toward the downstream face of the structure

Figure A.11.6.
Looking toward the downstream face of the structure

Figure A.11.7.
Looking at the Gunnison River downstream from the structure

Figure A.12.1. (K-08-D)
Looking toward the structure entrance

Figure A.12.2.
Looking toward the structure outlet

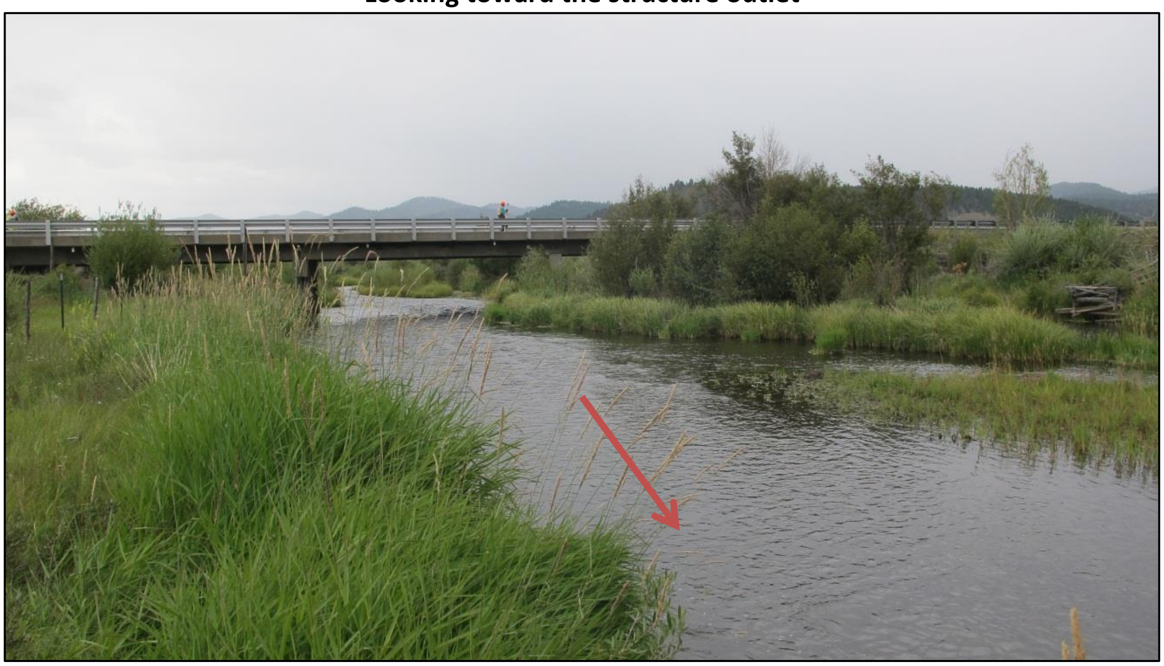


Figure A.12.3.
Looking toward Cebolla Creek upstream from the structure

Figure A.12.4.
Looking toward Cebolla Creek downstream from the structure

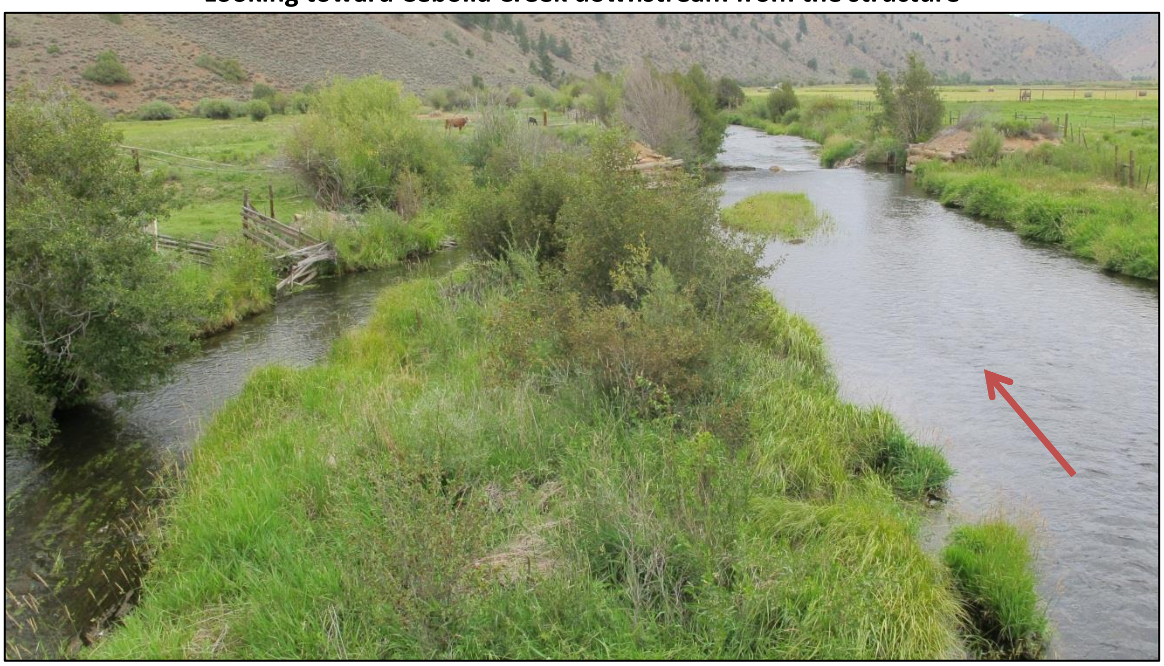


Figure A.12.5.
Roadway looking toward increasing roadway station

Figure A.12.6.
Roadway looking toward decreasing roadway station

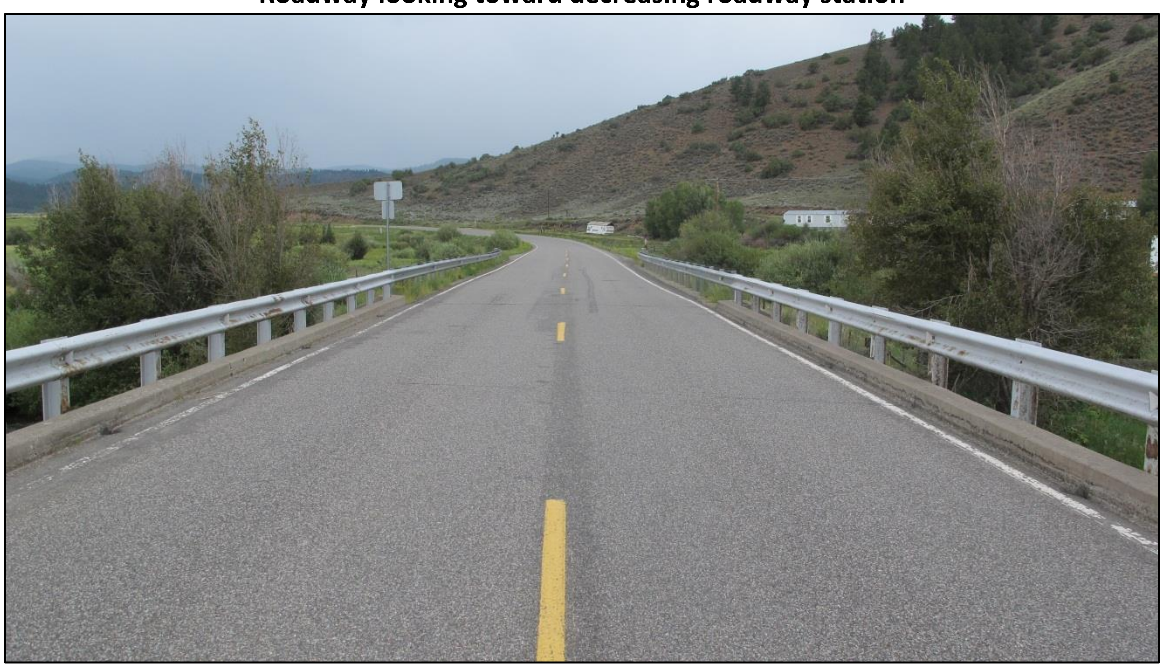


Figure A.12.7.
Looking toward left abutment

Figure A.12.8.
Looking toward right abutment

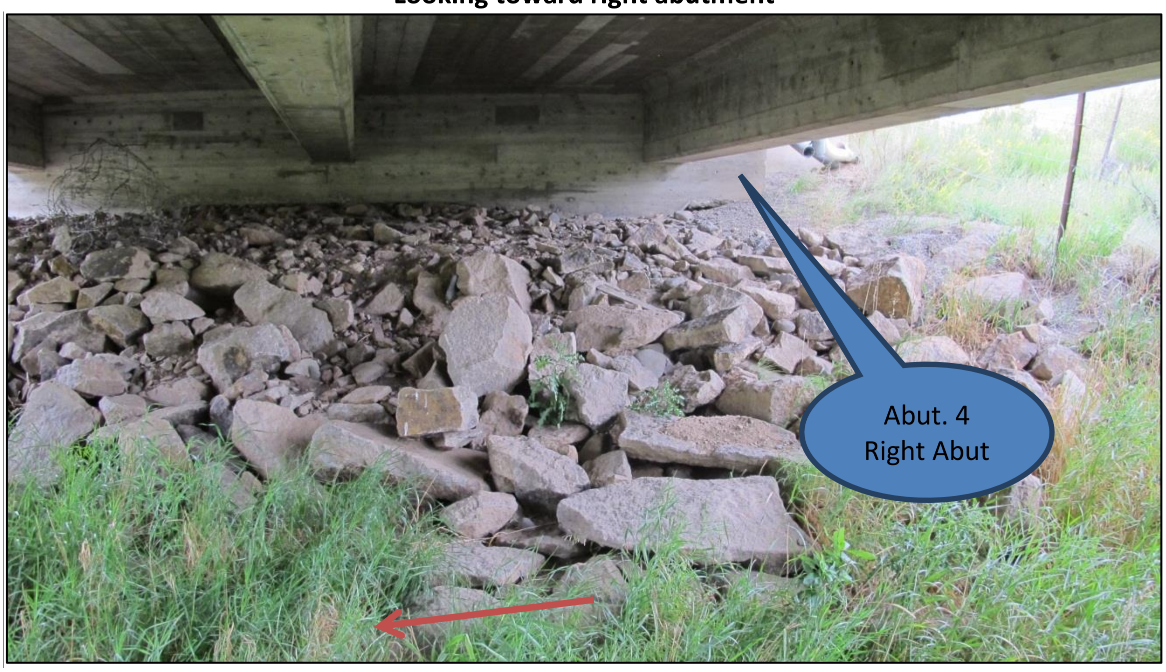


Figure A.12.9.
Looking at drop structure downstream of bridge

Figure A.12.10.
Looking at drop structure downstream of bridge

Figure A.13.1. (L-07-A)
Looking toward the structure entrance

Figure A.13.2.
Looking toward the structure outlet

Figure A.13.3.
Looking toward Lake Fork Gunnison River upstream from the structure

Figure A.13.4.
Looking toward Lake Fork Gunnison River downstream from the structure

Figure A.13.5.
Roadway looking toward increasing roadway station

Figure A.13.6.
Roadway looking toward decreasing roadway station

Figure A.13.7.
Looking toward left abutment

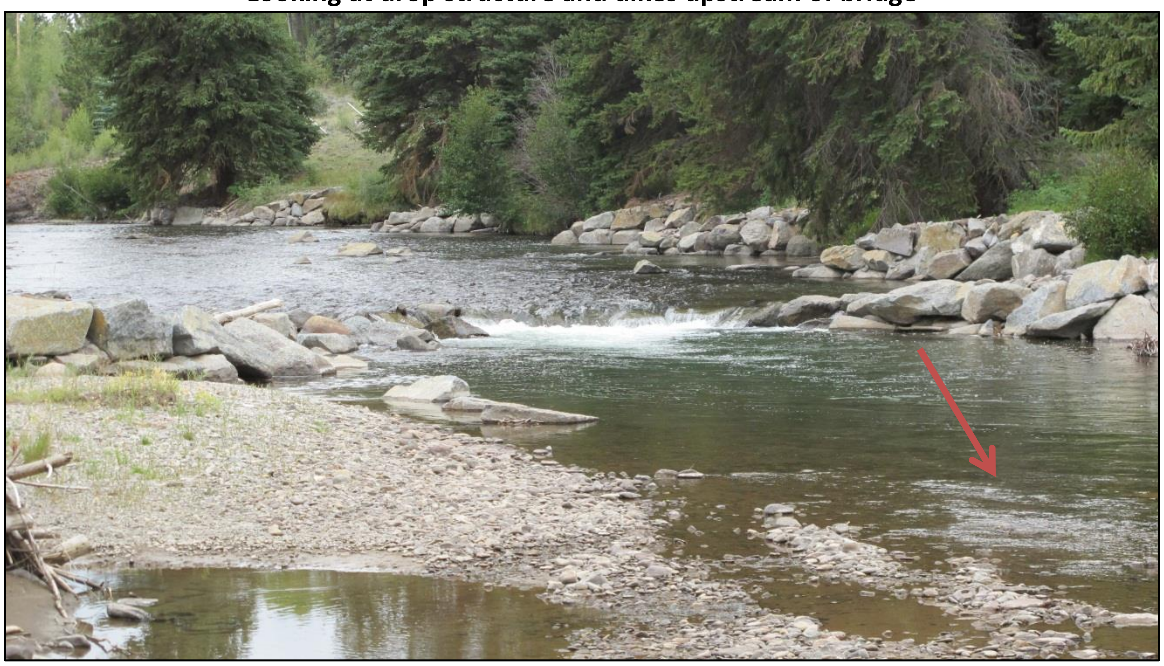
Figure A.13.8.
Looking toward right abutment

Figure A.13.9.
Looking at drop structure downstream of bridge

Figure A.13.10.
Looking at drop structure downstream of bridge

Figure A.13.11.
Looking at multiple dikes upstream of bridge

Figure A.13.12.
Looking at drop structure and dikes upstream of bridge



APPENDIX B – HYDROLOGIC ANALYSIS

Figure B.1.1. (E-10-A)
Drainage Basin at E-10-A (USGS StreamStats)

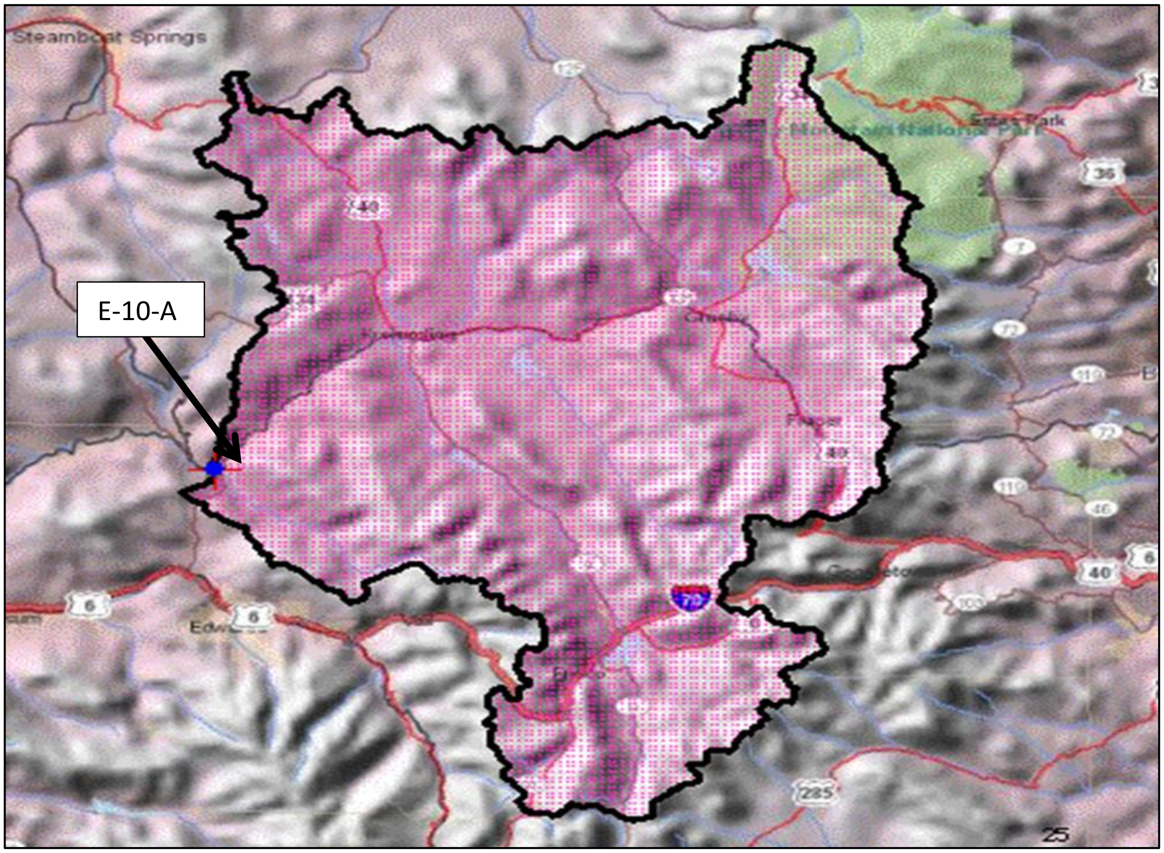


Table B.1.1.
Basin Characteristics Report (USGS StreamStats)

Parameter	Value
6-hour, 100-year precipitation, in inches	2.07
Mean basin slope computed from 10 m DEM, in percent	22.9
Area that drains to a point on a stream in square miles	2660
Mean Basin Elevation in feet	7770
Mean annual precipitation, in inches	23.91
Percentage of basin above 7500 ft elevation	79.1

StreamStats Ungaged Site Report

Date: Wed Aug 31 2011 10:46:39 Mountain Daylight Time
NAD27 Latitude: 39.8567 (39 51 24)
NAD27 Longitude: -106.6499 (-106 38 60)
NAD83 Latitude: 39.8567 (39 51 24)
NAD83 Longitude: -106.6505 (-106 39 02)

Warning from delineation: STREAMFLOW REGULATED--EQUATIONS DO NOT APPLY

Error: ComputeFlows: No intersecting region found for PeakFlows.

Log Pearson III Gage Analysis

A log Pearson III analysis of the stream gage #9058000 was made. The gage is located near Kremmling and has 62 years of record from 1905 to 2010. The gage drainage area is 2,379 square miles. The regional skew is -0.3 from the Bulletin 17B regional skewness map. The number of years of record is greater than 50, indicating that the record length is adequate. The adopted skewness of 0.05 was applied to adjust the flood frequency curve.

Application of the 1999 and 2009 USGS Regression equations for Colorado produces much lower estimates than the gage analysis. The Colorado Stream Stats program does not compute the flood frequency due to the large drainage area that would result in extrapolation of the equations. The computation of the flood frequency using the equation typically produces larger estimates than the gage estimates because the large drainage area typically has reservoirs that tend to decrease the flood frequency estimates.

Table B.1.2 lists the log Pearson III flood frequency estimates and the 1999 and 2009 USGS regional regression equation estimates.

State Highway 131 Structure E-10-A

The Colorado River highway 131 crossing has a drainage area of 2,660 square miles. That drainage area is only 11% larger than the drainage area of the stream gage indicating no area adjustment is required. The area adjustment exponent from the Colorado 2009 equation is 0.78 to 0.74. Area adjustment increases the discharge estimates approximately 8%. Area adjustment was applied using the 2009 USGS regression equation area exponents for the mountain hydrologic region. Table B.1.2 lists the area adjusted discharge estimates. The area adjusted estimates may be used for hydraulic and scour analysis at this site.

Table B.1.2.
Flood Frequency

Return Period yr	log Pearson III cfs	Adjusted log Pearson WRC cfs	USGS EQ 2009 cfs	USGS EQ 1999 cfs	Area Adjusted Highway 131 cfs
2	4014	4080	5130	3890	4373
5	7983	8028	7210	6080	8596
10	11613	11505	8860	7700	12319
25	17520	16954	9700	9870	18122
50	22950	21786	11700	11500	23287
100	29280	27250	13300	13200	29127
200	36541	33337	14700	14900	35634
500	47560	42274	16400	17100	45146

Equation show much less discharge than gage
Equations are extrapolated
Adjusted using regional skew -0.3
Colorado River near Kremmling
Stream Gage #9058000
Area adjusted based on 2009 equations area exponents for mountain region

Figure B.1.2.
Flood Frequency Curves

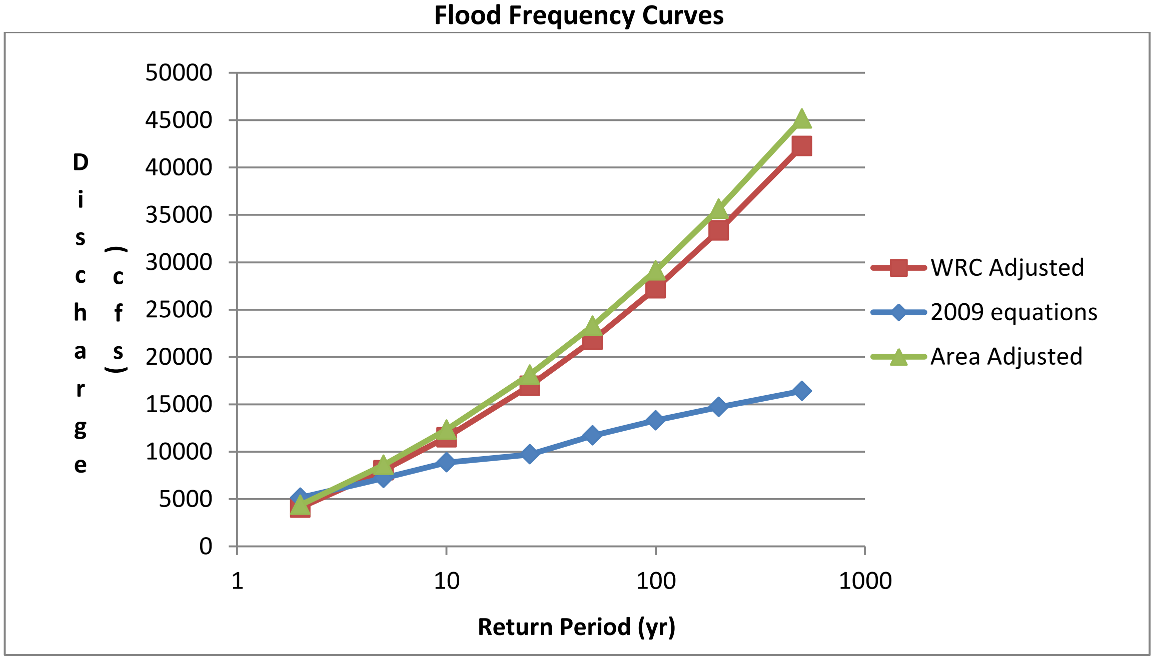


Figure B.2.1. (F-06-M)
Drainage Basin at F-06-M (USGS StreamStats)

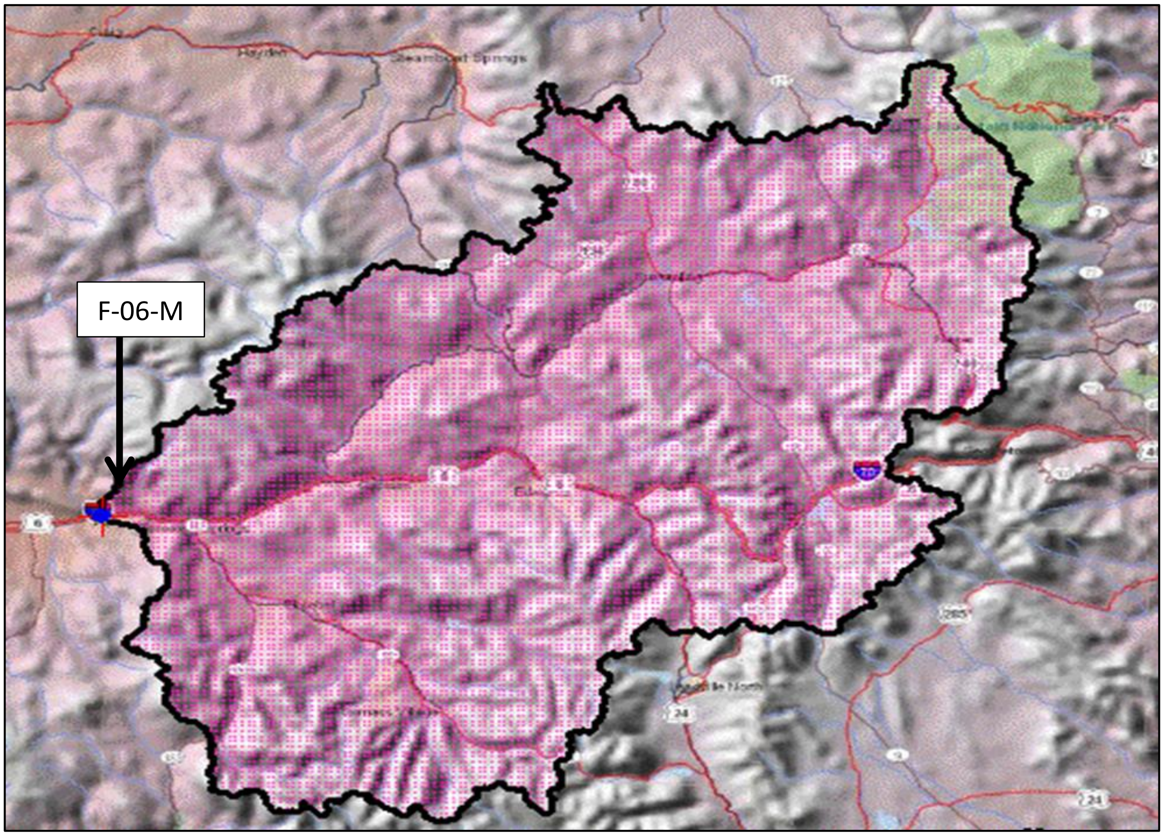


Table B.2.1.
Basin Characteristics Report (USGS StreamStats)

Parameter	Value
6-hour, 100-year precipitation, in inches	2.13
Mean basin slope computed from 10 m DEM, in percent	31.3
Area that drains to a point on a stream in square miles	6120
Mean Basin Elevation in feet	9400
Mean annual precipitation, in inches	25.43
Percentage of basin above 7500 ft elevation	90.2

Streamstats Ungaged Site Report

Date: Wed Aug 31 2011 11:59:18 Mountain Daylight Time
NAD27 Latitude: 39.5647 (39 33 53)
NAD27 Longitude: -107.5165 (-107 30 60)
NAD83 Latitude: 39.5646 (39 33 53)
NAD83 Longitude: -107.5172 (-107 31 02)

Warning from delineation: STREAMFLOW REGULATED--EQUATIONS DO NOT APPLY

Error: ComputeFlows: No intersecting region found for PeakFlows.

Colorado River near Glenwood

<u>Hydrology</u>

Colorado River at Glenwood Springs has a drainage area of 1800 sq miles. The peak runoff is primarily due to snowmelt. The gage (9163500) near the Utah Border and the Kremling gage (9058000) were used to interpolate the estimate for Glenwood Canyon. The Kremling gage has a drainage area of 2379 square miles. The Utah gage has a much larger area of 16900 sq miles.

This site drainage area is 4560 sq miles near Glenwood Springs.

<u>Conclusion</u>

The log Pearson III gage study results were used for this site. The 100-year flood peak of 35298 cfs and 500-year peak discharge of 52931 cfs from the log Pearson III analysis of records.

Table B.2.2.

Flood Frequency

					Computed
Kremling	9058000		Near Utah	9163500	Glenwood
Area	2379 sq mi		16900 sq mi		4560 sq mi
		WRC		WRC	
	cfs	cfs	cfs	cfs	cfs
2	4014	4038	24465	24358	7070
2.3	4630	4657	26876	26768	7955
5	7983	8000	37232	37222	12375
10	11613	11575	45339	45527	16707
25	17520	17313	55011	55583	23237
50	22950	22519	61729	62668	28915
100	29280	28522	67990	69348	35298
200	36541	35333	73812	75629	42412
500	47560	45546	80857	83321	52931

Figure B.2.2.
Stage-Discharge Curve

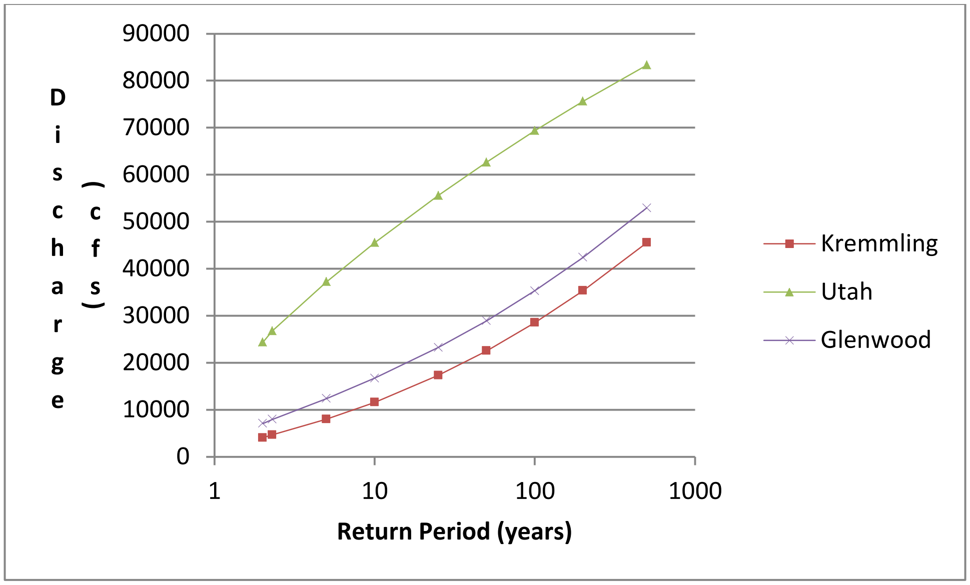


Figure B.3.1. (H-02-S)
Drainage Basin at H-02-S (USGS StreamStats)

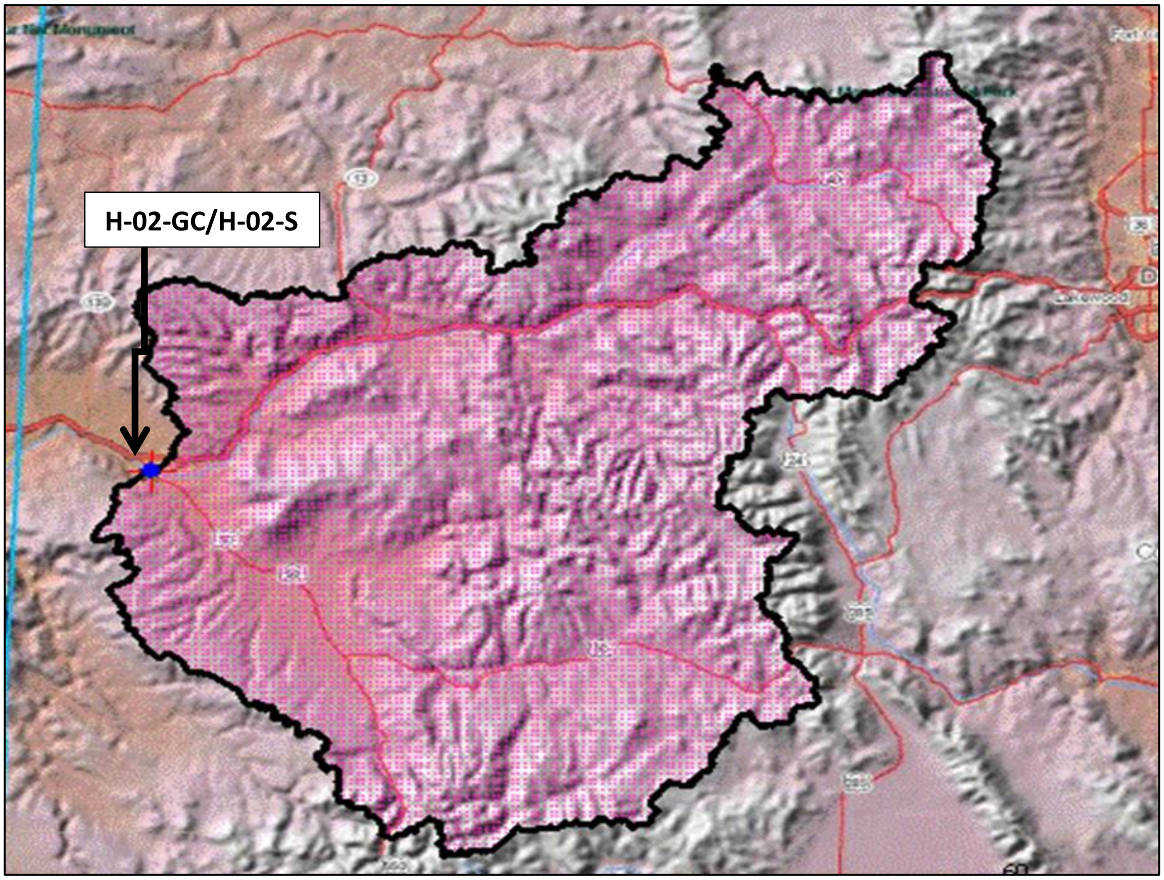


Table B.3.1.
Basin Characteristics Report (USGS StreamStats)

Parameter	Value
6-hour, 100-year precipitation, in inches	2.11
Mean basin slope computed from 10 m DEM, in percent	28.3
Area that drains to a point on a stream in square miles	16900
Mean Basin Elevation in feet	8750
Mean annual precipitation, in inches	22.31
Percentage of basin above 7500 ft elevation	76

Streamstats Ungaged Site Report

Date: Wed Aug 31 2011 14:30:27 Mountain Daylight Time
NAD27 Latitude: 39.0670 (39 04 01)
NAD27 Longitude: -108.5826 (-108 34 57)
NAD83 Latitude: 39.0670 (39 04 01)
NAD83 Longitude: -108.5832 (-108 34 60)

Warning from delineation: STREAMFLOW REGULATED--EQUATIONS DO NOT APPLY

Error: ComputeFlows: No intersecting region found for PeakFlows.

<u>Log Pearson III Gage Analysis</u>

A log Pearson III analysis of the stream gage # 9153000 was made. The gage is located near the Utah Border with 61 years of record from 1951 to 2010. The gage drainage area is 17,843 square miles. The regional skew is -0.3 from the Bulletin 17B regional skewness map. Both the unadjusted and adjusted estimates are listed in Table B.3.2. Application of the 1999 and 2009 USGS Regression equations for Colorado produces lower estimates than the gage. The Colorado Stream stats program does not compute the flood frequency due to the large drainage area that would result in extrapolation of the equations outside of recommended ranges. Application of the equations however provides some insight as to how well they may extrapolate and if there may be some reservoir storage affect in the gage analysis. Table B.3.2. lists the log Pearson III flood frequency estimates and the 1999 and 2009 USGS regional regression equation estimates.

<u>State Highway 340 Structure H-02-S and H02-GC</u>

The Colorado River highway 340 crossing has a drainage area of 16900 square miles. The site drainage area is only 5% smaller than the drainage area of the stream gage indicating that area adjustment is minor. Table B.3.2. lists the area adjusted discharge estimates that are recommended to be used for hydraulic and scour analysis at this site.

<u>Colorado Stream stats</u>

The Colorado Stream Stats program indicates this site is outside the range of the regression equations due to regulation of stream flows and the large drainage area. The 2009 equations were applied outside of the Colorado Stream Stats environment since it provides results useful in comparison to stream gage analysis. The equations expectedly produced larger peak flood estimates than the stream gage analysis.

Colorado Stream Stats Basin Characteristics

H-02-S State Highway 340

Basin Characteristics Report

H-02-S H-02-GC

Colorado River

Basin Characteristics Report

Date: Sun Oct 16 2011 20:39:27 Mountain Daylight Time

NAD27 Latitude: 39.0669 (39 04 01)

NAD27 Longitude: -108.5819 (-108 34 55)

NAD83 Latitude: 39.0669 (39 04 01)

NAD83 Longitude: -108.5825 (-108 34 57)

Parameter Value

6-hour, 100-year precipitation, in inches 2.11

Mean basin slope computed from 10 m DEM, in percent 28.3

Area that drains to a point on a stream in square miles 16900

Mean Basin Elevation in feet 8750

Mean annual precipitation, in inches 22.32

Percentage of basin above 7500 ft elevation 76.1

Table B.3.2.
USGS StreamStats Flood Frequency and Confidence Limits

```
Z09163500                        USGS

     H09163500       39075810901350008080 77SW1401000517849  17843  4325

     N09163500       COLORADO RIVER NEAR COLORADO-UTAH STATE LINE
```

PERCENT CHANCE	RECURRENCE INTERVAL YEARS	UNADJUSTED K	UNADJUSTED FLOW CFS	WRC ADJUSTED K	WRC ADJUSTED FLOW CFS
99.0	1.0	-2.68670	5418.	-2.65149	5523.
98.0	1.0	-2.31459	6635.	-2.28995	6724.
96.0	1.0	-1.91245	8259.	-1.89783	8325.
90.0	1.1	-1.32121	11395.	-1.31841	11412.
80.0	1.3	-.80505	15091.	-.80936	15056.
66.6	1.5	-.35417	19290.	-.36187	19209.
50.0	2.0	.08238	24465.	.07427	24358.
42.9	2.3	.25498	26876.	.24759	26768.
20.0	5.0	.85369	37232.	.85321	37222.
10.0	10.0	1.21555	45339.	1.22315	45527.
4.0	25.0	1.57074	55011.	1.58975	55583.
2.0	50.0	1.78238	61729.	1.81012	62668.
1.0	100.0	1.95983	67990.	1.99615	69348.
.5	200.0	2.11077	73812.	2.15542	75629.
.2	500.0	2.27820	80857.	2.33334	83321.

Confidence limits upper and lower at two Standard Errors
95 % chance estimate is between limits
97.5 % chance below upper limit
Confidence limits upper and lower at one Standard Errors
68 % chance estimate is between limits
84 % chance below upper limit

Probability	Recurrence yr	95% Lower Limit	68%Lower Limit	WRC	68% Upper Limit	95% Upper Limit
99.0	1.0	3884.1	4673.7	5523.0	6361.8	7126.4
98.0	1.0	4915.3	5793.4	6724.4	7634.6	8458.9
96.0	1.0	6335.9	7307.1	8324.6	9311.8	10202.7
90.0	1.1	9177.6	10272.8	11411.9	12517.1	13520.9
80.0	1.3	12611.1	13802.5	15056.1	16295.9	17449.9
66.6	1.5	16510.3	17804.5	19209.5	20653.2	22055.5
50.0	2.0	21198.9	22675.1	24357.6	26183.7	28063.1
42.9	2.3	23323.1	24914.1	26767.7	28828.0	31001.0
20.0	5.0	32068.0	34357.9	37222.2	40658.3	44576.8
10.0	10.0	38610.6	41624.8	45526.9	50385.4	56142.5
4.0	25.0	46215.1	50233.6	55583.3	62452.3	70860.0
2.0	50.0	51415.9	56202.5	62668.1	71107.5	81620.3
1.0	100.0	56224.0	61770.1	69347.5	79367.0	92024.5
.5	200.0	60673.3	66960.2	75629.0	87213.4	102017.8
.2	500.0	66038.3	73262.1	83320.9	96916.2	114509.2

```
HIGH OUTLIER LIMIT 109606.40 cfs  T    2.83700
LOW OUTLIER LIMIT   4992.42 cfs  T    2.83700
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Figure B.4.1. (H-04-Z)
Drainage Basin at H-04-Z (USGS StreamStats)

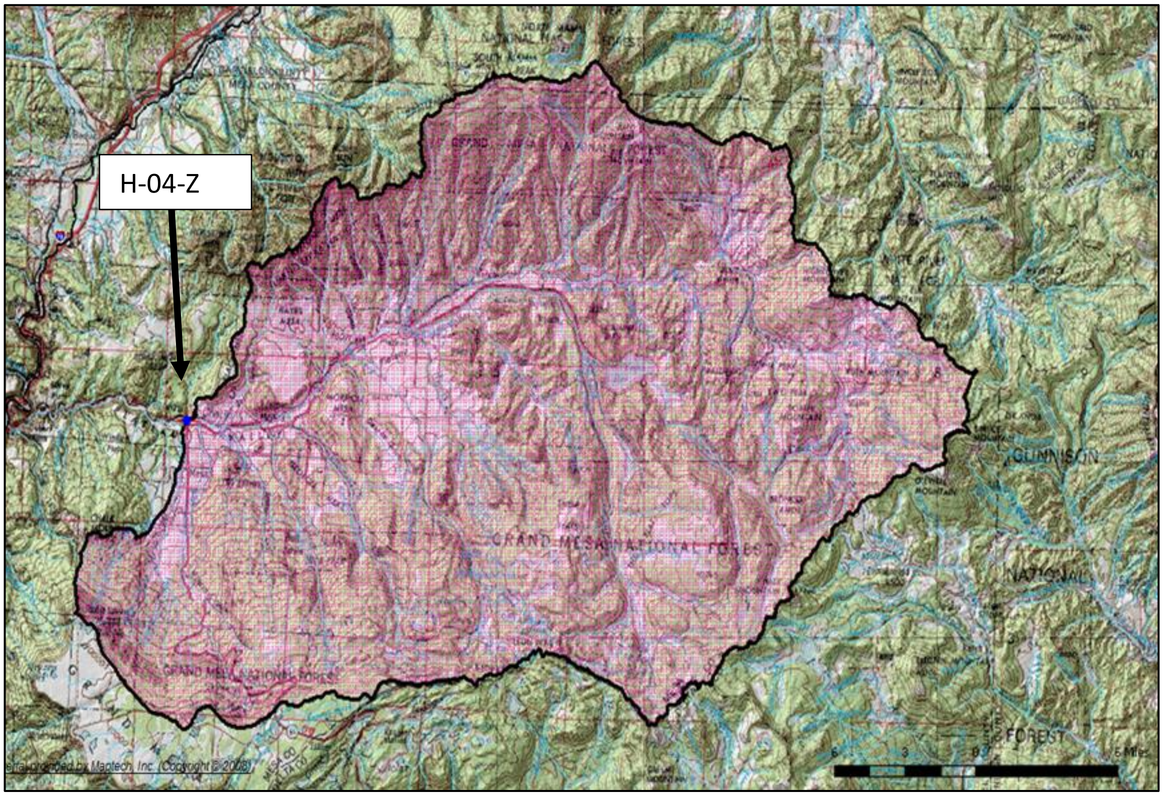


Table B.4.1.
Basin Characteristics Report (USGS StreamStats)

Parameter	Value
Mean basin slope computed from 10 m DEM, in percent	21.9
Area that drains to a point on a stream in square miles	546
Mean Basin Elevation in feet	8390

Table B.4.2.
USGS StreamStats Peak-Flows Streamflow Statistics

Peak-Flows Streamflow Statistics Area-Averaged			
Statistic	**Flow (ft^3/s)**	**Prediction Error (percent)**	**Equivalent years of record**
PK2	1870	68	
PK5	2760	57	
PK10	3380	52	
PK25	3980	50	
PK50	4720	50	
PK100	5420	48	
PK200	5930	48	
PK500	6790	47	

Figure B.5.1. (H-07-H)
Drainage Basin at H-07-H (USGS StreamStats)

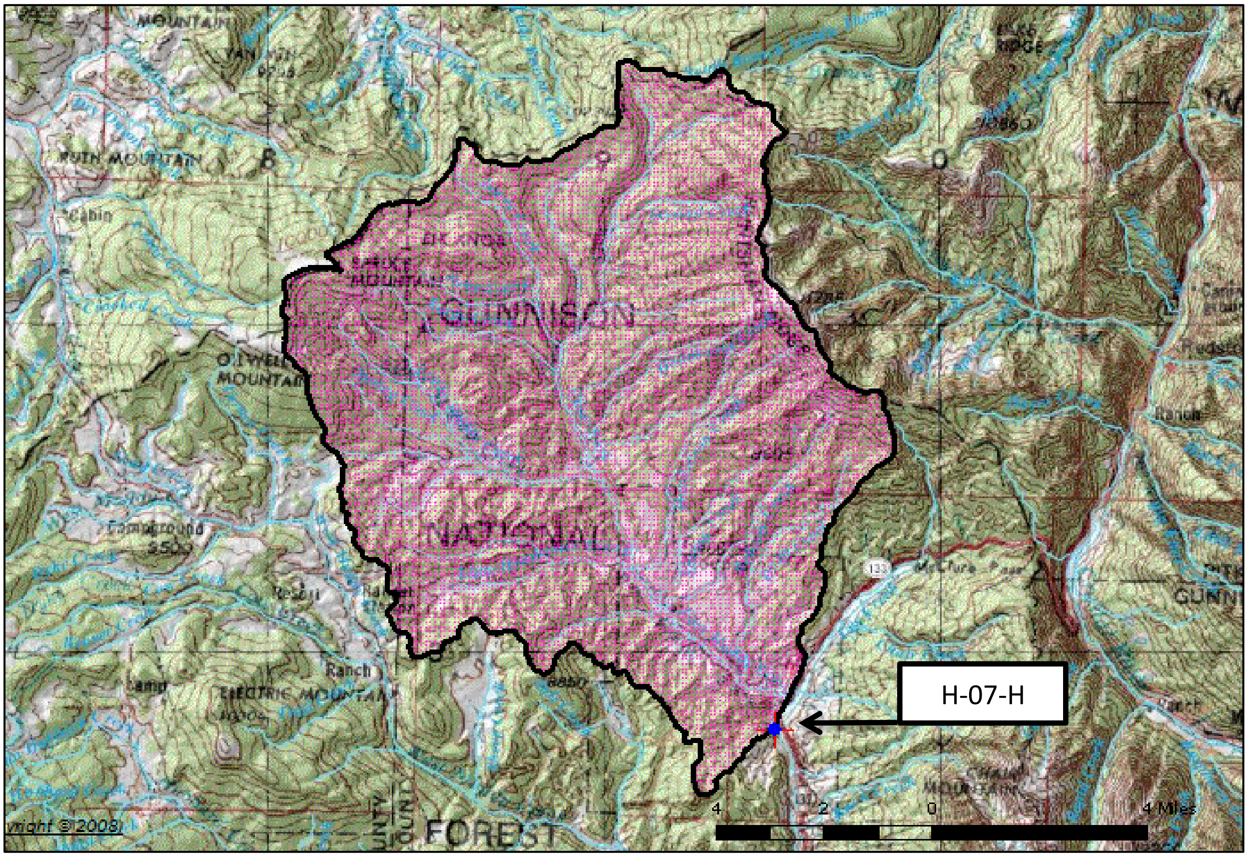


Table B.5.1.
Basin Characteristics Report (USGS StreamStats)

Parameter	Value
6-hour, 100-year precipitation, in inches	2.27
Mean basin slope computed from 10 m DEM, in percent	27.3
Area that drains to a point on a stream in square miles	113
Mean Basin Elevation in feet	8720
Mean annual precipitation, in inches	28.85
Percentage of basin above 7500 ft elevation	89.9

Table B.5.2.
USGS StreamStats Basin Characteristics

Peak-Flows Basin Characteristics			
89% Mountain Region Peak Flow (81.4 mi2)			
Parameter	**Value**	**Regression Equation Valid Range**	
		Min	**Max**
Drainage Area	91		
Mean Basin Slope from 10m DEM			
Mean Annual Precipitation	28.46		
11% Northwest Region Peak Flow (9.58 mi2)			
Parameter	**Value**	**Regression Equation Valid Range**	
		Min	**Max**
Drainage Area	91		
Percent above 7500 ft			
Mean Annual Precipitation	28.46		

Table B.5.3.
USGS StreamStats Peak-Flows Streamflow Statistics Area-Averaged

Peak-Flows Streamflow Statistics Area-Averaged			
Statistic	**Flow (ft^3/s)**	**Prediction Error (percent)**	**Equivalent years of record**
PK2	708	56	
PK5	990	49	
PK10	1180	45	
PK25	1360	44	
PK50	1610	43	
PK100	1800	40	
PK200	1950	40	
PK500	2210	38	

Figure B.6.1. (H-11-AA)
Drainage Basin at H-11-AA (USGS StreamStats)

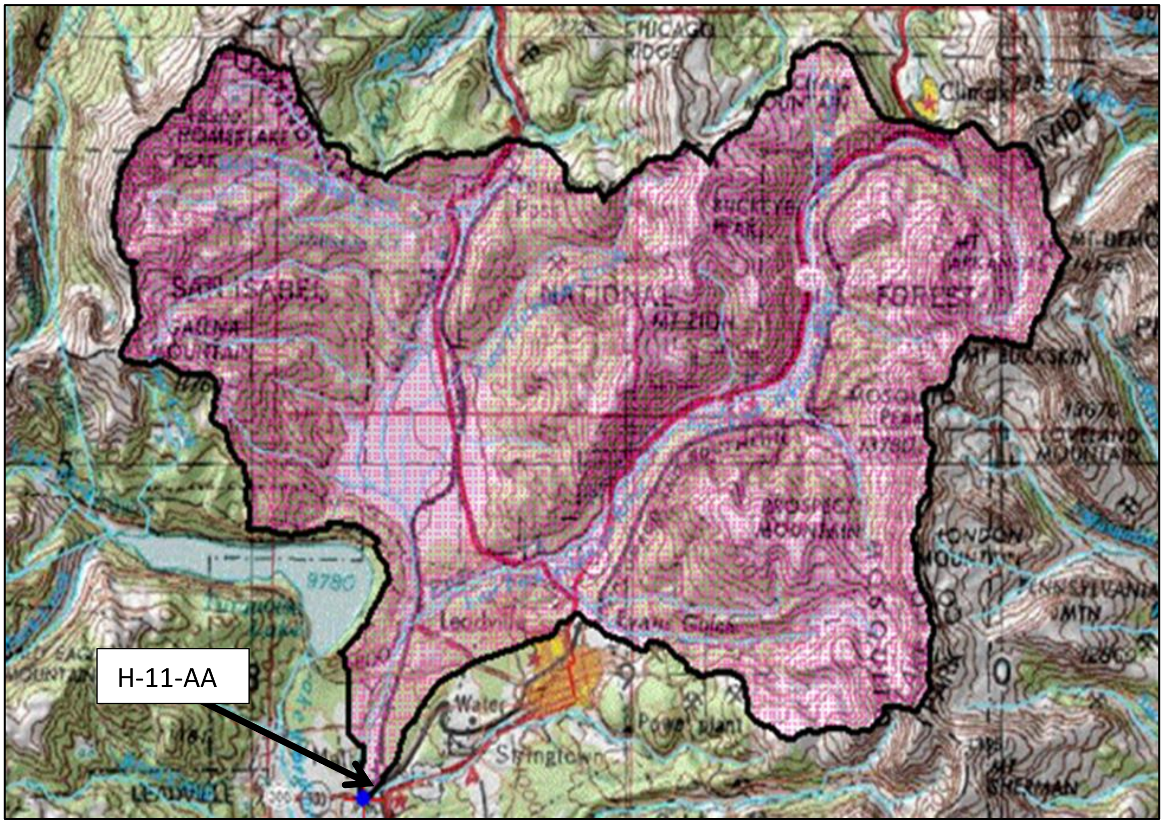


Table B.6.1.
Basin Characteristics Report (USGS StreamStats)

Parameter	Value
6-hour, 100-year precipitation, in inches	2.18
Mean basin slope computed from 10 m DEM, in percent	27.4
Area that drains to a point on a stream in square miles	102
Mean Basin Elevation in feet	11100
Mean annual precipitation, in inches	23.36
Percentage of basin above 7500 ft elevation	100

Table B.6.2.
USGS StreamStats Peak-Flows Streamflow Statistics

Peak-Flows Streamflow Statistics					
Statistic	Flow (ft^3/s)	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
PK2	431	49			
PK5	628	44			
PK10	772	41			
PK25	906	40			
PK50	1100	39			
PK100	1240	36			
PK200	1370	36			
PK500	1590	33			

Figure B.7.1. (H-11-U)
Drainage Basin at H-11-U (USGS StreamStats)

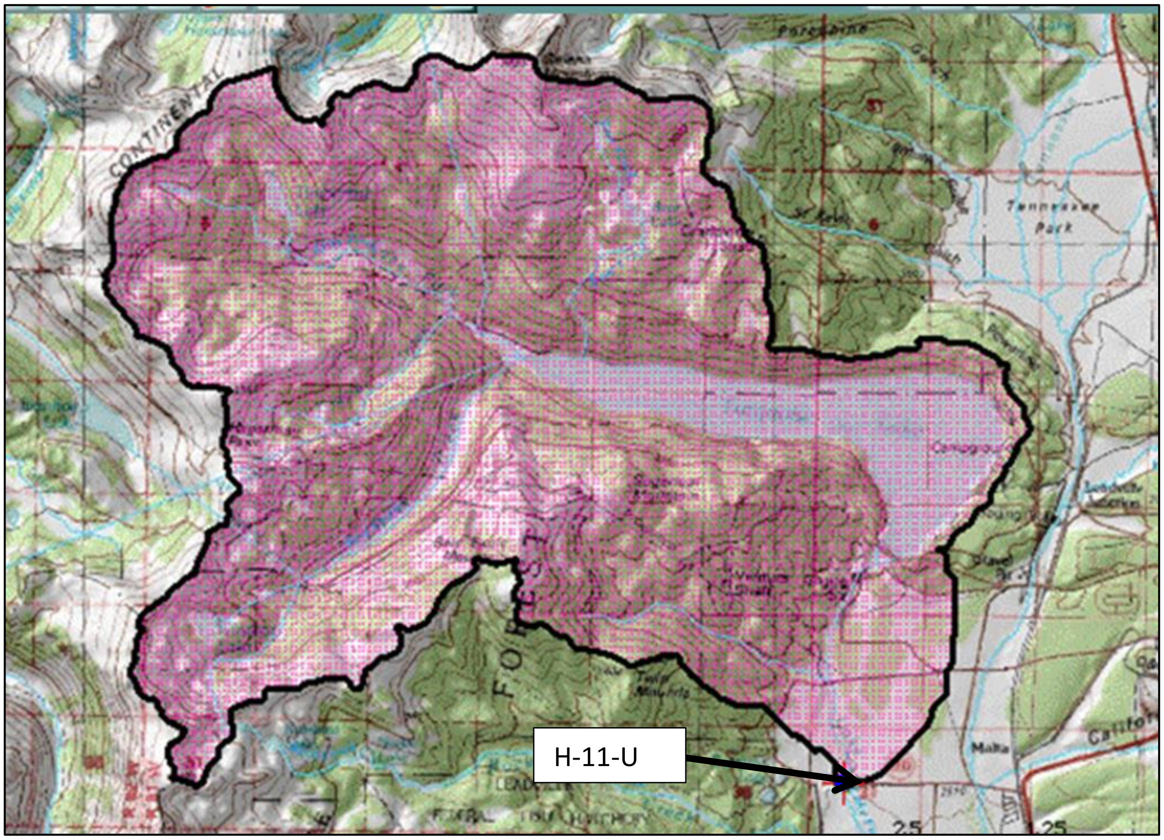


Table B.7.1.
Basin Characteristics Report (USGS StreamStats)

Parameter	Value
6-hour, 100-year precipitation, in inches	2.33
Mean basin slope computed from 10 m DEM, in percent	27.9
Area that drains to a point on a stream in square miles	34.4
Mean Basin Elevation in feet	10800
Mean annual precipitation, in inches	27.50
Percentage of basin above 7500 ft elevation	100

Table B.7.2.
USGS StreamStats Peak-Flows Streamflow Statistics

Peak-Flows Streamflow Statistics					
Statistic	**Flow (ft^3/s)**	**Prediction Error (percent)**	**Equivalent years of record**	**90-Percent Prediction Interval**	
				Minimum	**Maximum**
PK2	261	49			
PK5	369	44			
PK10	443	41			
PK25	518	40			
PK50	618	39			
PK100	688	36			
PK200	748	36			
PK500	860	33			

Figure B.8.1. (I-06-C)
Drainage Basin at I-06-C (USGS StreamStats)

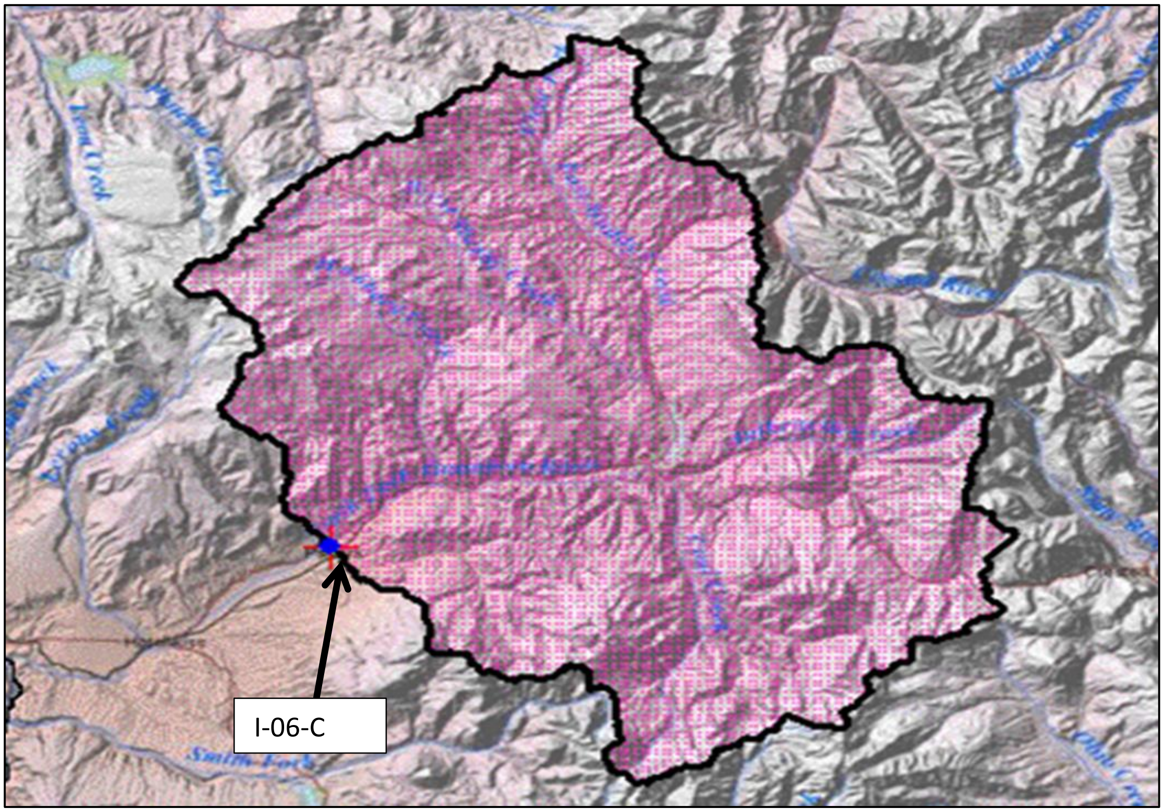


Table B.8.1.
Basin Characteristics Report (USGS StreamStats)

Parameter	Value
6-hour, 100-year precipitation, in inches	2.26
Mean basin slope computed from 10 m DEM, in percent	32
Area that drains to a point on a stream in square miles	721
Mean Basin Elevation in feet	8680
Mean annual precipitation, in inches	27.12
Percentage of basin above 7500 ft elevation	82.6

Table B.8.2.
USGS StreamStats Basin Characteristics

Peak-Flows Basin Characteristics			
82% Mountain Region Peak Flow (592 mi2)			
Parameter	**Value**	**Regression Equation Valid Range**	
		Min	**Max**
Drainage Area (square miles)	721	1	1060
Mean Basin Slope from 10m DEM (percent)	32	7.6	60.2
Mean Annual Precipitation (inches)	27.12	18	47
18% Northwest Region Peak Flow (129 mi2)			
Parameter	**Value**	**Regression Equation Valid Range**	
		Min	**Max**
Drainage Area (square miles)	721	1	5250
Percent above 7500 ft (percent)	82.6	0	99
Mean Annual Precipitation (inches)	27.12	8	49

Table B.8.3.
USGS StreamStats Peak-Flows Streamflow Statistics Area-Averaged

Peak-Flows Streamflow Statistics Area-Averaged			
Statistic	**Flow (ft^3/s)**	**Prediction Error (percent)**	**Equivalent years of record**
PK2	2630	60	
PK5	3720	52	
PK10	4480	48	
PK25	5110	46	
PK50	6050	45	
PK100	6810	43	
PK200	7400	43	
PK500	8380	41	

Figure B.9.1. (J-01-C)
Drainage Basin at J-01-C (USGS StreamStats)

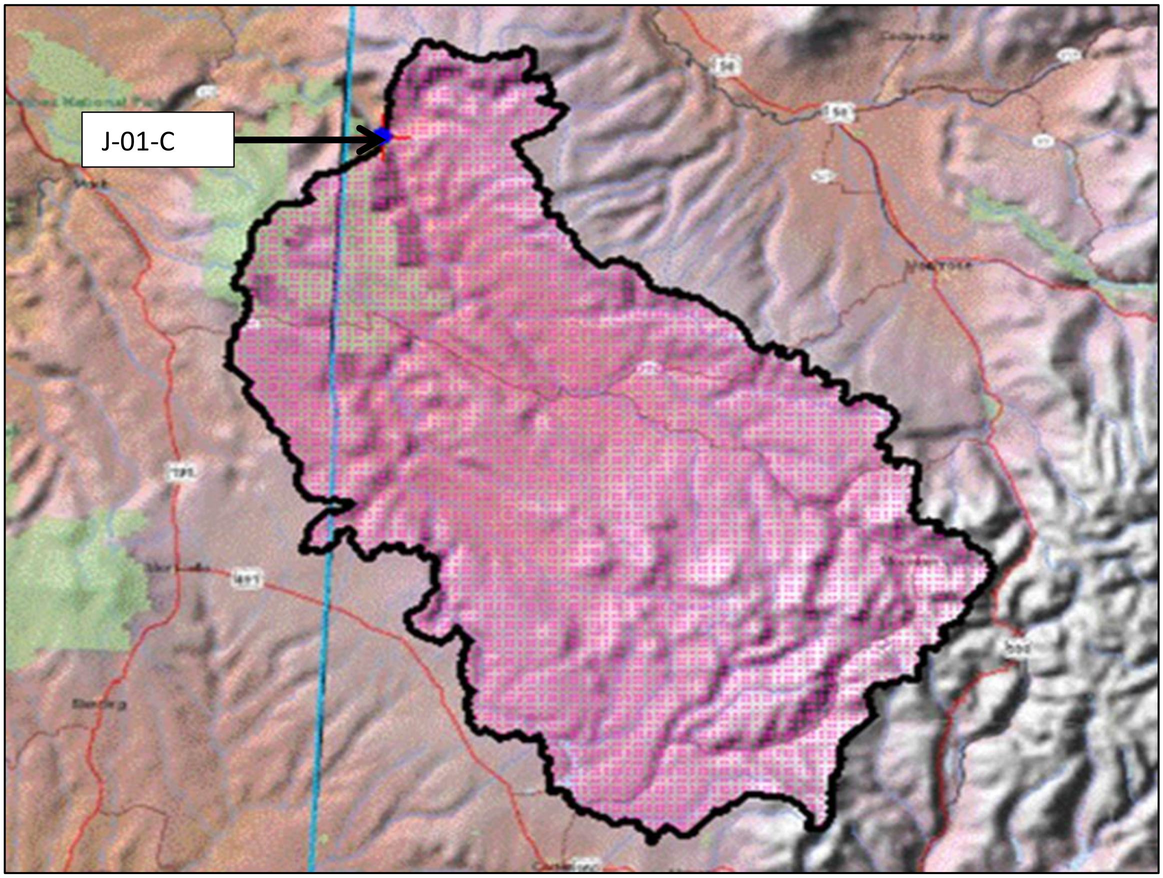


Table B.9.1.
Basin Characteristics Report (USGS StreamStats)

Parameter	Value
6-hour, 100-year precipitation, in inches	2.20
Mean basin slope computed from 10 m DEM, in percent	23.1
Area that drains to a point on a stream in square miles	4360
Mean Basin Elevation in feet	7750
Mean annual precipitation, in inches	21.33
Percentage of basin above 7500 ft elevation	52.4

StreamStats Ungaged Site Report

Date: Fri Sep 9 2011 10:50:54 Mountain Daylight Time
NAD27 Latitude: 38.6806 (38 40 50)
NAD27 Longitude: -108.9793 (-108 58 45)
NAD83 Latitude: 38.6806 (38 40 50)
NAD83 Longitude: -108.9799 (-108 58 48)

Warning from delineation: STREAMFLOW REGULATED--EQUATIONS DO NOT APPLY

Error: ComputeFlows: No intersecting region found for PeakFlows.

Hydrology:

The Delores River crossing of highway 141 has a drainage area of 4360 square miles. Stream gage 9169500 has a drainage area of 2025 square miles. The watershed is located in the Southwest hydrologic region portions of which are mountainous.

Colorado Stream stats

The Colorado Stream Stats program indicates this site is outside the range of the regression equations due to regulation of stream flows and the large drainage area. The 2009 equations were applied outside of the Colorado Stream Stats environment since it provides results useful in comparison to stream gage analysis. The equations expectedly produced larger peak flood estimates than the stream gage analysis.

Stream Gage

The Delores River stream gage 9-169500 has a drainage area of 2025 square miles. The gage has records from 1918 to 2010. Some years of record however are missing. A total of 44 years were used in the analysis. A log Pearson III analysis was performed on this gage data. The regional skew of -0.1 was used. The station skew was computed to be -.51 and the weighted skew of -0.44 was used to produce the skew adjusted estimates. Area adjustment of the log Pearson III gage analysis was made based on the gage and site drainage areas. The gage area is approximated one half the site area indication substantial extrapolation. The area adjustment exponents for the mountain region were used. The area adjusted gage estimates are similar to the 2009 mountain equations. The 2009 equations however are larger than may be attributed to regulation or the watershed. A comparison with the Colorado River was also made since the Delores is a tributary. The Delores flood frequency peak is less that the Colorado River flood frequency curves as related to drainage area; the unit discharge per square miles is less for Delores than for the Colorado River. The peak runoff is primarily due to snowmelt. The gage (9163500) near the Utah Border and the Kremmling gage (9058000) were used to interpolate the estimate for Glenwood Canyon. The Kremmling gage has a drainage area of 2379 square miles. The Utah gage has a much larger area of 16900 square miles. The Delores results were plotted to see how they line up with the Colorado River gage analysis. That

Conclusion

The area adjusted log Pearson III gage study results are recommended for this site. The 100-year flood peak of 20080cfs and 500-year peak discharge of 25936cfs are recommended for scour analysis.

Table B.9.2.
Flood Frequency

Return Period yr	log Pearson III cfs	Adjusted log Pearson WRC cfs	Mountain USGS EQ 2009 cfs	Mountain USGS EQ 1999 cfs	Area Adjusted gage WRC cfs	USGS Southwest 2009 cfs
2	3097	3051	6480	5850	5549	6720
5	5397	5391	9320	9200	8595	11500
10	6998	7096	11600	11700	11313	15300
25	9027	9347	12800	15100	14723	21400
50	10501	11053	15700	17600	17410	25200
100	11920	12748	18000	20300	20080	30900
200	13274	14419	20000	22900	22712	34000
500	14954	16566	22500	26500	25936	44700

Colorado Stream Stats indicates no application
Equations are extrapolated
Adjusted using regional skew -0.3
Delores site area 4360 square miles
Stream Gage #9169500 gage area 2025 square miles
Area adjusted based on 2009 equations area exponents for mountain region

Figure B.9.2.
Flood Frequency Curves

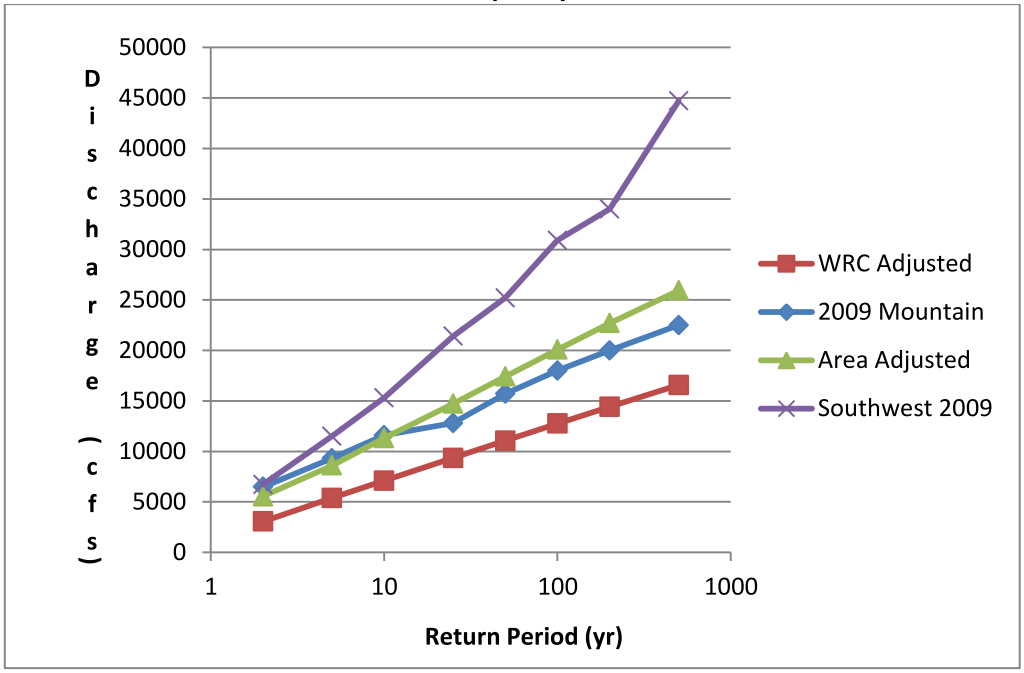


Figure B.10.1. (J-01-D)
Drainage Basin at J-01-D (USGS StreamStats)

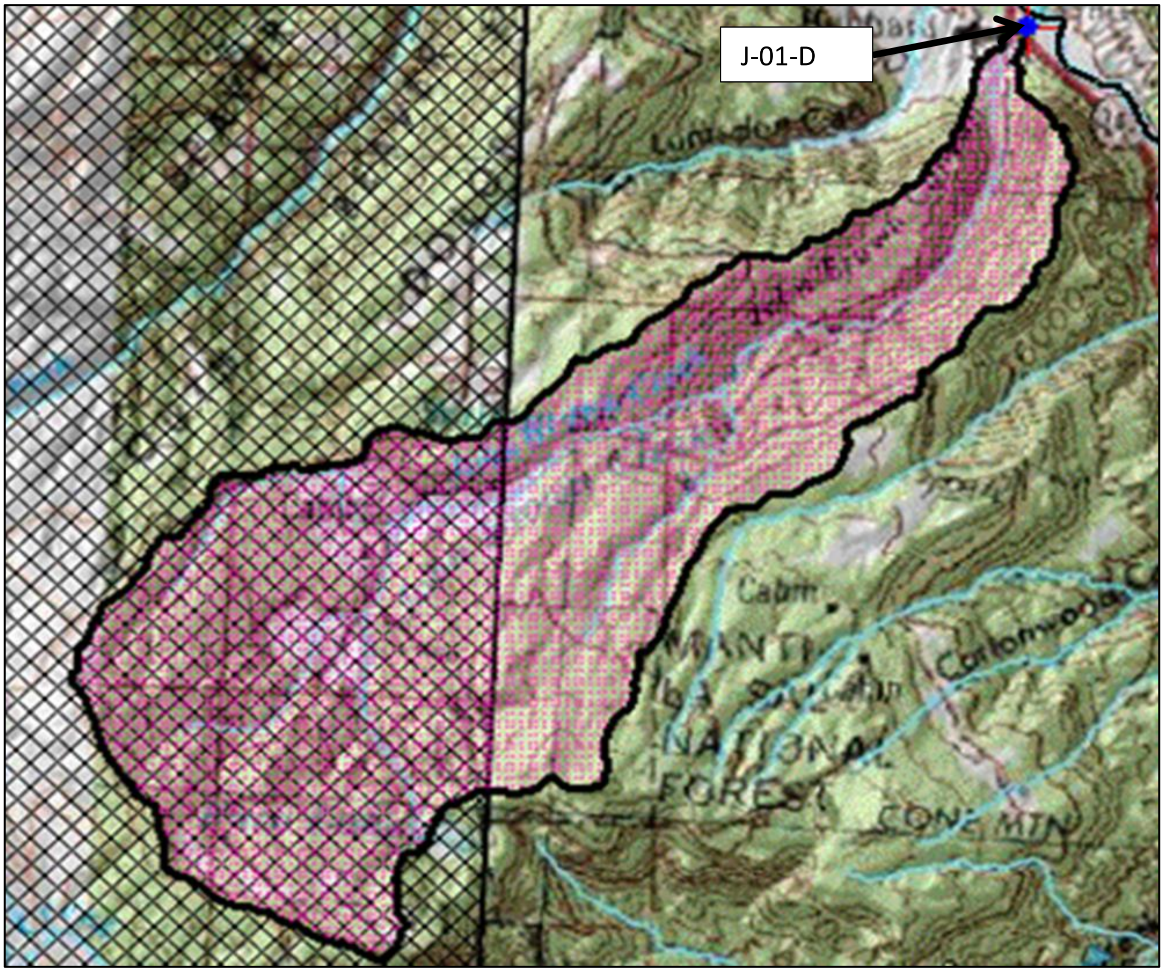


Table B.10.1.
Basin Characteristics Report (USGS StreamStats)

Parameter	Value
6-hour, 100-year precipitation, in inches	2.10
Mean basin slope computed from 10 m DEM, in percent	21.2
Area that drains to a point on a stream in square miles	26.8
Mean Basin Elevation in feet	7550
Mean annual precipitation, in inches	22.50
Percentage of basin above 7500 ft elevation	68.9

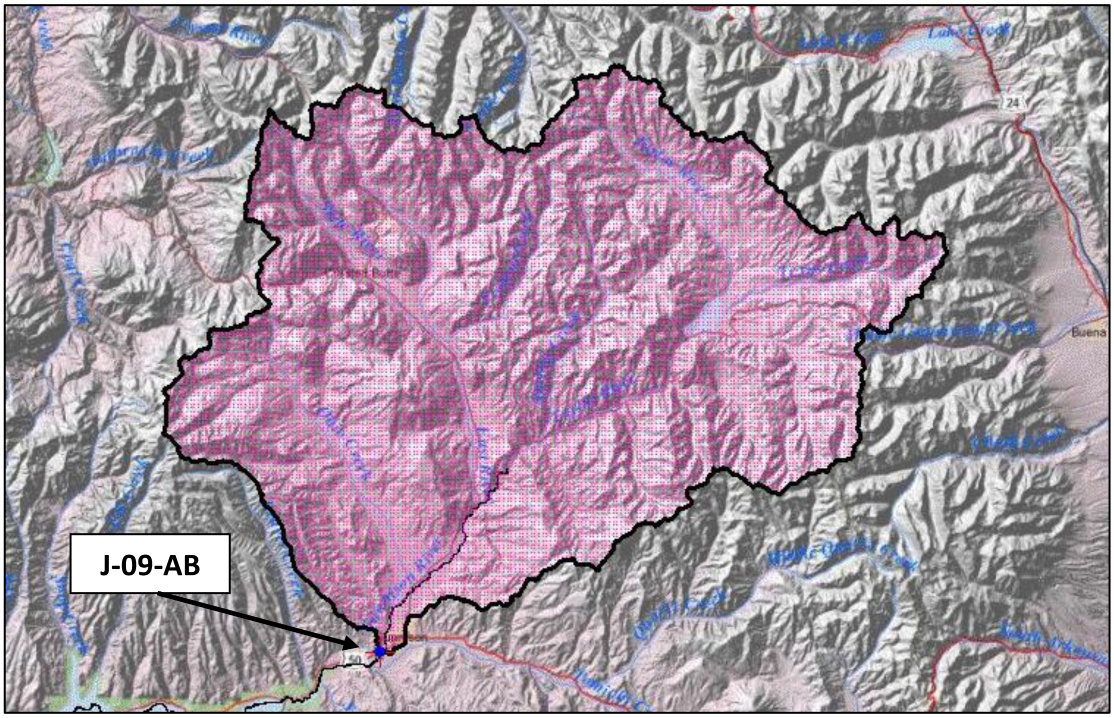
Table B.10.2.
USGS StreamStats Basin Characteristics

Peak-Flows Basin Characteristics			
100% Southwest Region Peak Flow (26.8 mi2)			
Parameter	**Value**	**Regression Equation Valid Range**	
		Min	**Max**
Drainage Area (square miles)	26.8	1	4390
Percent above 7500 ft (percent)	68.9	0	99

Table B.10.3.
USGS StreamStats Peak-Flows Streamflow Statistics

Peak-Flows Streamflow Statistics					
Statistic	**Flow (ft^3/s)**	**Prediction Error (percent)**	**Equivalent years of record**	**90-Percent Prediction Interval**	
				Minimum	**Maximum**
PK2	251	90			
PK5	462	71			
PK10	641	67			
PK25	931	66			
PK50	1150	67			
PK100	1390	69			
PK200	1600	71			
PK500	2080	75			

Figure B.11.1. (J-09-AB)
Gunnison River Basin above Bridge J-09-AB



The Gunnison River is located in the Mountainous hydrologic region where the peak runoff is primarily due to snowmelt. In general, in Colorado rainfall events at higher elevations (above 7,500ft) have much less intensity than the events occurring at lower elevations. Rainfall on snow is a potential that may produce large peak runoffs. In previous FEMA hydrologic studies for the Gunnison River, stream gage analysis was used. Table B.11.1 summarizes the flood frequency estimates from the USGS regression equations, the current log-Pearson Type III analysis using Water Resources Council Bulletin 17B methodology with the most current gage data (1911 up to 2009), and the results of the 1989 FEMA National Flood Insurance Study.

Table B.11.1.

Summary of Gunnison River discharges near Gunnison, Colorado.

Return Period Years	USGS Regression Discharge cfs	Log-Pearson Type III WRC Adjusted Dischargecfs	FEMA (1989) Discharge cfs
2	2670	3627	
5	3960	5348	
10	4880	6443	5762
25	6080	7759	
50	6950	8682	7967
100	7890	9554	8930
200	8760	10369	
500	9940	11371	11256
Basin Slope = 0.298 ft/ft			
Basin Drainage area= 1,012 square miles			

StreamStats USGS Regression

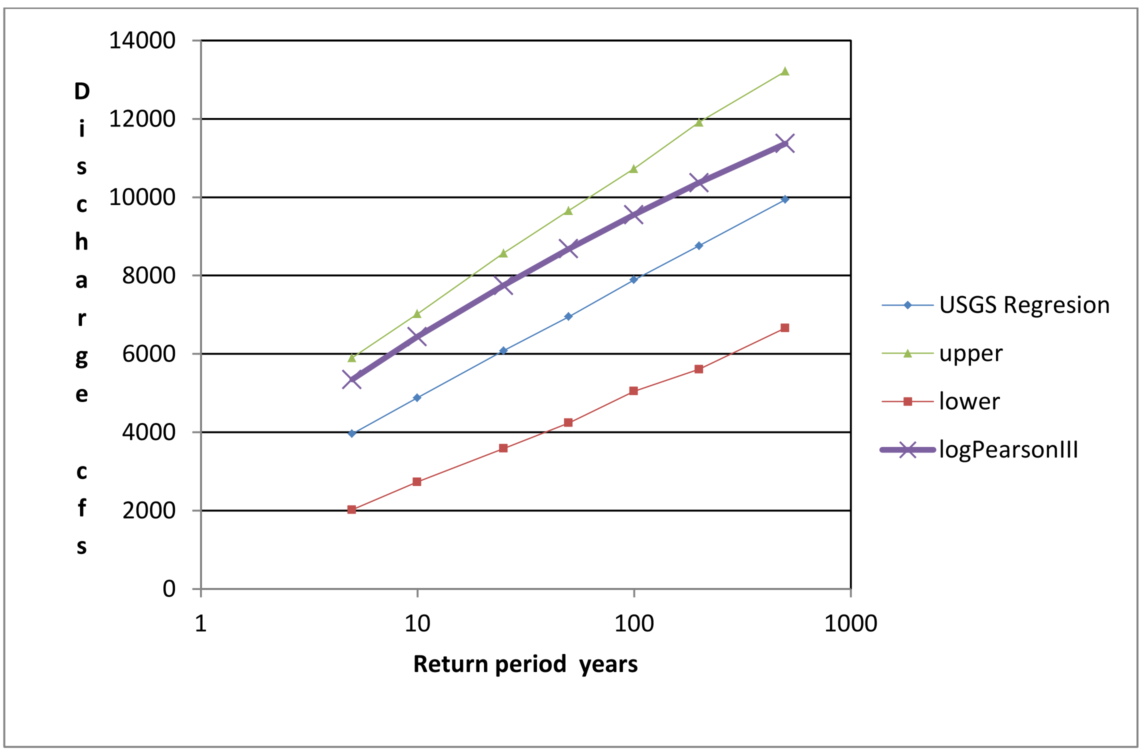
The Colorado Stream Stats program was used to estimate the watershed characteristics. The drainage area was estimated to be 1,012 square miles (Figure B.11.1). The mean basin slope is reported to be 0.298, mean elevation is given as 10,200ft, and the mean annual precipitation is reported to be 25.6 inches. The 6-hr, 100-year precipitation is given as 2.19 inches. The Colorado StreamStats program did not provide flood frequency estimates using the regression equations. The StreamStats program indicated that the regression equations were not valid because the Gunnison River is regulated at Bridge J-09-AB. The USGS regression equations were developed to produce the flood frequency for unregulated watershed conditions. The valid range of these regression equations is 1 to 1,060 square miles. The USGS strictly indicates that the regression equations do not apply if the watershed is regulated. However, it is useful to use these equations to estimate the flood frequency for unregulated conditions. For the Gunnison River case, the regression equations estimated lower discharge values than the log-Pearson Type III method.

These lower estimates are not attributed to the regulation effects. Rather, the error of estimates using the regression equations may be the reason for the lower estimates than the log- Pearson Type III discharges. All of the regression equation estimates are lower than the 68% lower log-Pearson Type III confidence interval. The upper band of confidence interval for the regression equations, however, is within 68% lower band of the log-Pearson Type III discharges. The log-Pearson Type III analysis also has error of estimate as shown in Table B.11.2 and in the graph of the flood frequency estimates.

The StreamStats restrictive implementation of the regression equations is likely to prevent the novice user from getting estimates that may be questionable without further study. The Blue Mesa Reservoir is located downstream and does not affect the flood frequency at the highway 50 crossing. The regulatory conditions above the highway 50 crossing would be irrigation diversions.

Figure B.11.2.

Comparison of USGS Regression Equation with Log-Pearson Type III Results



Log-Pearson Type III Analysis

The Water Resource Council (WRC) Bulletin 17B methodology was used in order to compute the log-Pearson Type III flood-frequency distribution. For this purpose, the FORTRAN computer program given in WRC Bulletin 17B was used in the analysis. The regional skew of 0.0 was used in the adjusted flood frequency curve. The regional skew is weighted with the computed station skew based on the number of years of record.

The log-Pearson Type III analysis was conducted using USGS stream gage record at Gunnison from 1911 through 2009 for the gage 09114500. In this period of record, the largest peak of 11,400cfs occurred in 1918. This discharge is computed to be approximately a 500-year event.

The high outlier for the log-Pearson Type III distribution is 15,119cfs. The largest peak in 1918 did not exceed the high outlier. The low outlier is 813cfs. The 1977 discharge of 708cfs is lower than the low outlier threshold. The low outlier was not adjusted since it is not significantly below the low outlier estimate.

Figure B.11.3.

Log-Pearson Type III Analysis Results for the Gunnison River

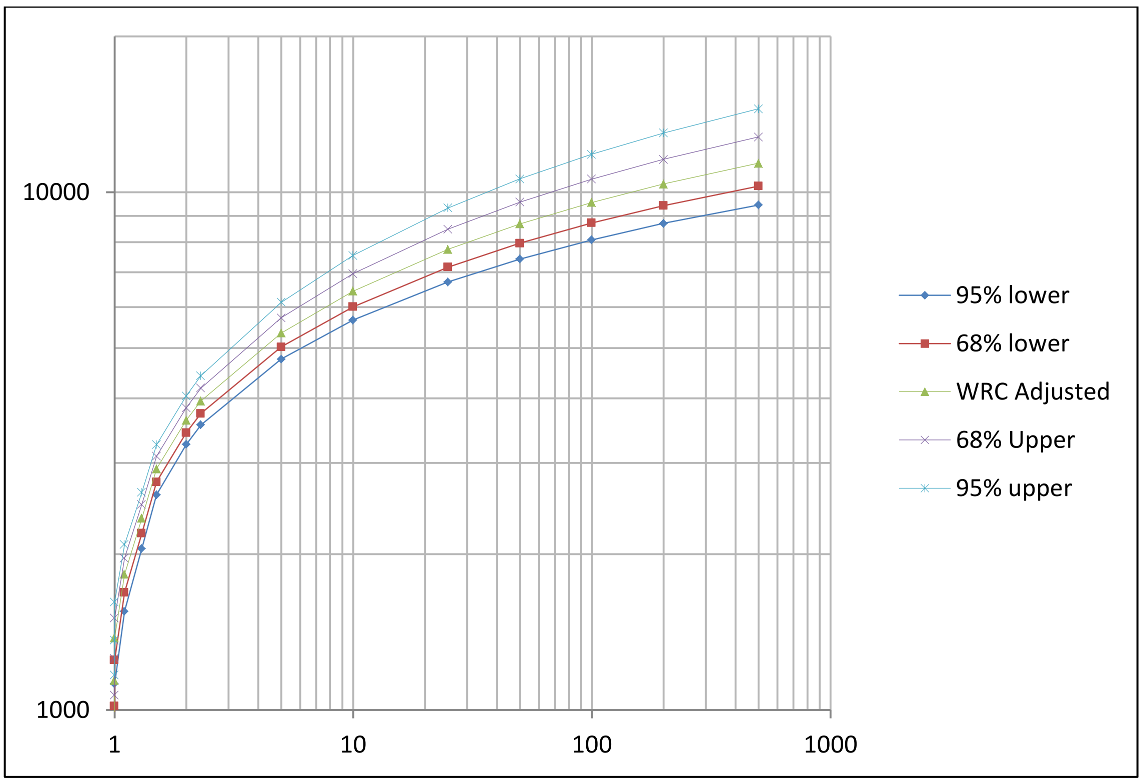


Table B.11.2.

WRC Bulletin 17B log-Pearson Type III Analysis Results

Probability	Recurrence Interval Years	95% Lower Limit Discharge cfs	68% Lower Limit Discharge cfs	WRC Adjusted Discharge cfs	68% Limit Limit Discharge cfs	95% Upper Limit Discharge cfs
99	1	737	843.9	957.2	1067.9	1168.1
98	1	902.7	1018.5	1140	1258	1364.2
96	1	1124.3	1249	1378.9	1504.3	1617
90	1.1	1551.7	1687.4	1828.3	1964.7	2088
80	1.3	2050.5	2194.4	2345.6	2494.5	2632
66.6	1.5	2603.5	2757.1	2923.2	3092.1	3253.6
50	2	3258.5	3431.6	3626.7	3834.6	4043
42.9	2.3	3553.3	3739.1	3952.5	4184.5	4422
20	5	4760.8	5025.3	5348	5722	6130.4
10	10	5661.4	6007.7	6442.6	6962.6	7548.7
4	25	6707.7	7167.5	7758.7	8483.8	9322.8
2	50	7424.1	7970.8	8682.4	9567.1	10605.2
1	100	8087.6	8720.4	9551.9	10596.8	11836.9
0.5	200	8703.1	9420	10369.4	11572.8	13014.3
0.2	500	9447.5	10271.2	11371	12778.2	14480.6
High Outlier 15,119cfs						
Low outlier 813.4cfs						
Station Skew -.41						
Computed Skew -.51						

Regional skew 0.0

The log-Pearson Type III analysis was considered to be the best suited method of flood frequency estimation for this study. The USGS regression equations appear to underestimate the flood frequency when compared with the log-Pearson Type III analysis. In this report, the effects of irrigation diversions on the log-Pearson Type III analysis was not studied. The gage data on which the log Pearson III analysis is based on would include the effects of the irrigation diversions and return flows to the gage. Base flow was not subtracted from the gage discharges to estimate log-Pearson. However, for flooding events effects of irrigation diversions are minimal.

Figure B.12.1. (K-08-D)
Drainage Basin at K-08-D (USGS StreamStats)

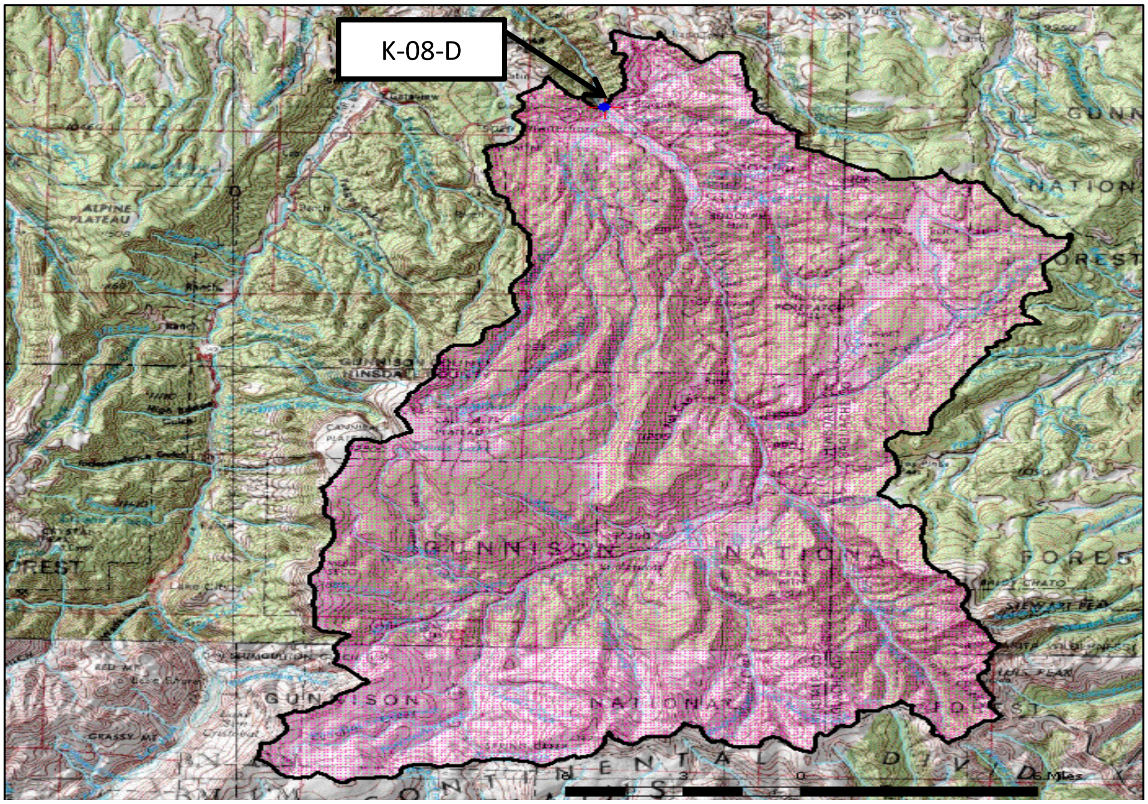


Table B.12.1.
Basin Characteristics Report (USGS StreamStats)

Parameter	Value
6-hour, 100-year precipitation, in inches	2.25
Mean basin slope computed from 10 m DEM, in percent	26.4
Area that drains to a point on a stream in square miles	340
Mean Basin Elevation in feet	10400
Mean annual precipitation, in inches	21.08
Percentage of basin above 7500 ft elevation	100

Table B.12.2.
USGS StreamStats Basin Characteristics

Peak-Flows Basin Characteristics			
100% Mountain Region Peak Flow (340 mi2)			
Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	340	1	1060
Mean Basin Slope from 10m DEM (percent)	26.4	7.6	60.2
Mean Annual Precipitation (inches)	21.09	18	47

Table B.12.3.
USGS StreamStats Peak-Flows Streamflow Statistics Area-Averaged

Peak-Flows Streamflow Statistics					
Statistic	Flow (ft^3/s)	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
PK2	885	49			
PK5	1310	44			
PK10	1630	41			
PK25	1900	40			
PK50	2320	39			
PK100	2660	36			
PK200	2960	36			
PK500	3440	33			

Figure B.13.1. (L-07-A)
Drainage Basin at L-07-A (USGS StreamStats)

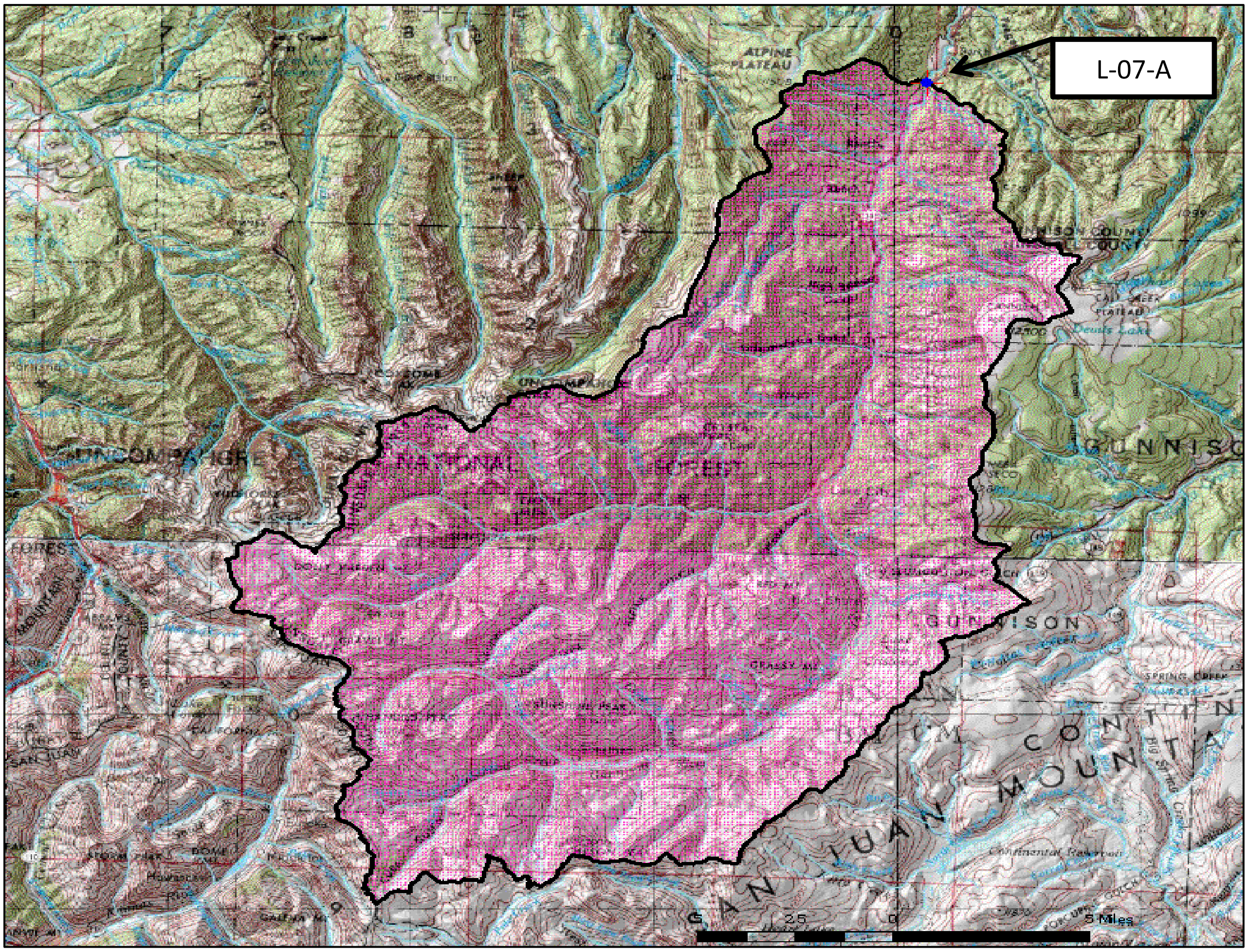


Table B.13.1.
Basin Characteristics Report (USGS StreamStats)

Parameter	Value
6-hour, 100-year precipitation, in inches	2.42
Mean basin slope computed from 10 m DEM, in percent	43.9
Area that drains to a point on a stream in square miles	305
Mean Basin Elevation in feet	11100
Mean annual precipitation, in inches	29.57
Percentage of basin above 7500 ft elevation	100

Table B.13.2.
USGS StreamStats Basin Characteristics

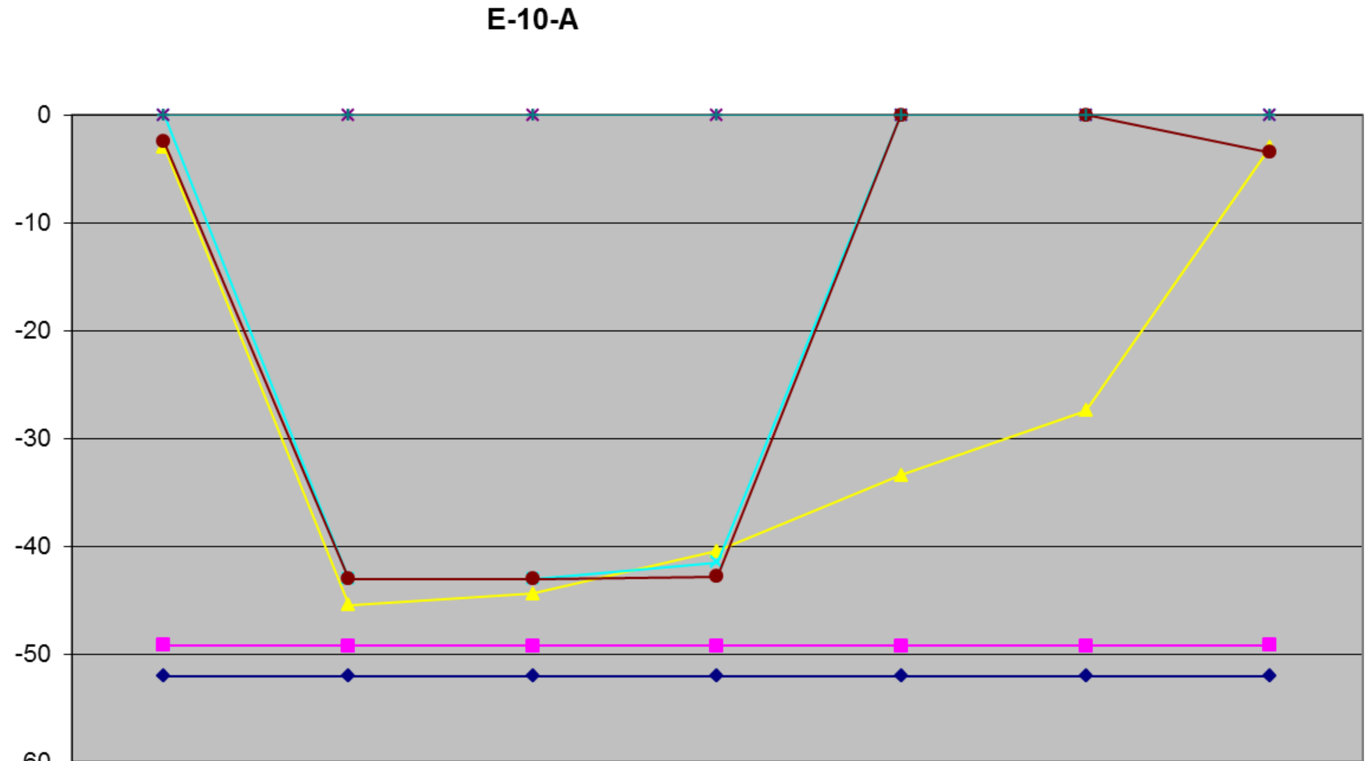
Peak-Flows Basin Characteristics			
100% Mountain Region Peak Flow (305 mi2)			
Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	305	1	1060
Mean Basin Slope from 10m DEM (percent)	43.9	7.6	60.2
Mean Annual Precipitation (inches)	29.56	18	47

Table B.13.3.
USGS StreamStats Peak-Flows Streamflow Statistics Area-Averaged

Peak-Flows Streamflow Statistics					
Statistic	Flow (ft^3/s)	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
PK2	1800	49			
PK5	2440	44			
PK10	2870	41			
PK25	3200	40			
PK50	3790	39			
PK100	4160	36			
PK200	4470	36			
PK500	5030	33			

Appendix C – CDOT Inspection Information

Figure C.1.1. (E-10-A)
CDOT Scour Inspection Charts



	Abut1	Pier2	Channel	Pier3	Pier4	Pier5	Abut6
1966 FOOTER BOTTOM	-52	-52	-52	-52	-52	-52	-52
500 YR SCOUR	-49.16	-49.2	-49.2	-49.2	-49.2	-49.2	-49.16
2006	-3	-45.41	-44.41	-40.41	-33.41	-27.41	-3
2004	0	-43	-43	-41.5	0	0	0
2002	0	0	0	0	0	0	0
2000	-2.5	-43	-43	-42.8	0	0	-3.5
1998	0	0	0	0	0	0	0

Figure C.1.2.
CDOT Scour Inspection Measurements

Bridge Number	**E-10-A**		**Scour**	5			
Highway	**131**	Drainage area	**1000 Square Miles**				
Span/type	**WGK**	Stream	**Colorado River**				
	Abut1	**Pier2**	**Channel**	**Pier3**	**Pier4**	**Pier5**	**Abut6**
1966 FOOTER BOTTOM	-52	-52	-52	-52	-52	-52	-52
500 YR SCOUR	-49.16	-49.2	-49.2	-49.2	-49.2	-49.2	-49.16
2006	-3	-45.41	-44.41	-40.41	-33.41	-27.41	-3
2004	0	-43	-43	-41.5	0	0	0
2002	0	0	0	0	0	0	0
2000	-2.5	-43	-43	-42.8	0	0	-3.5
1998	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0
1990	0	*40.0	-39	*39.00	0	0	0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0	0	0	0	0	0	0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Figure C.2.1. (F-06-M)
CDOT Scour Inspection Charts

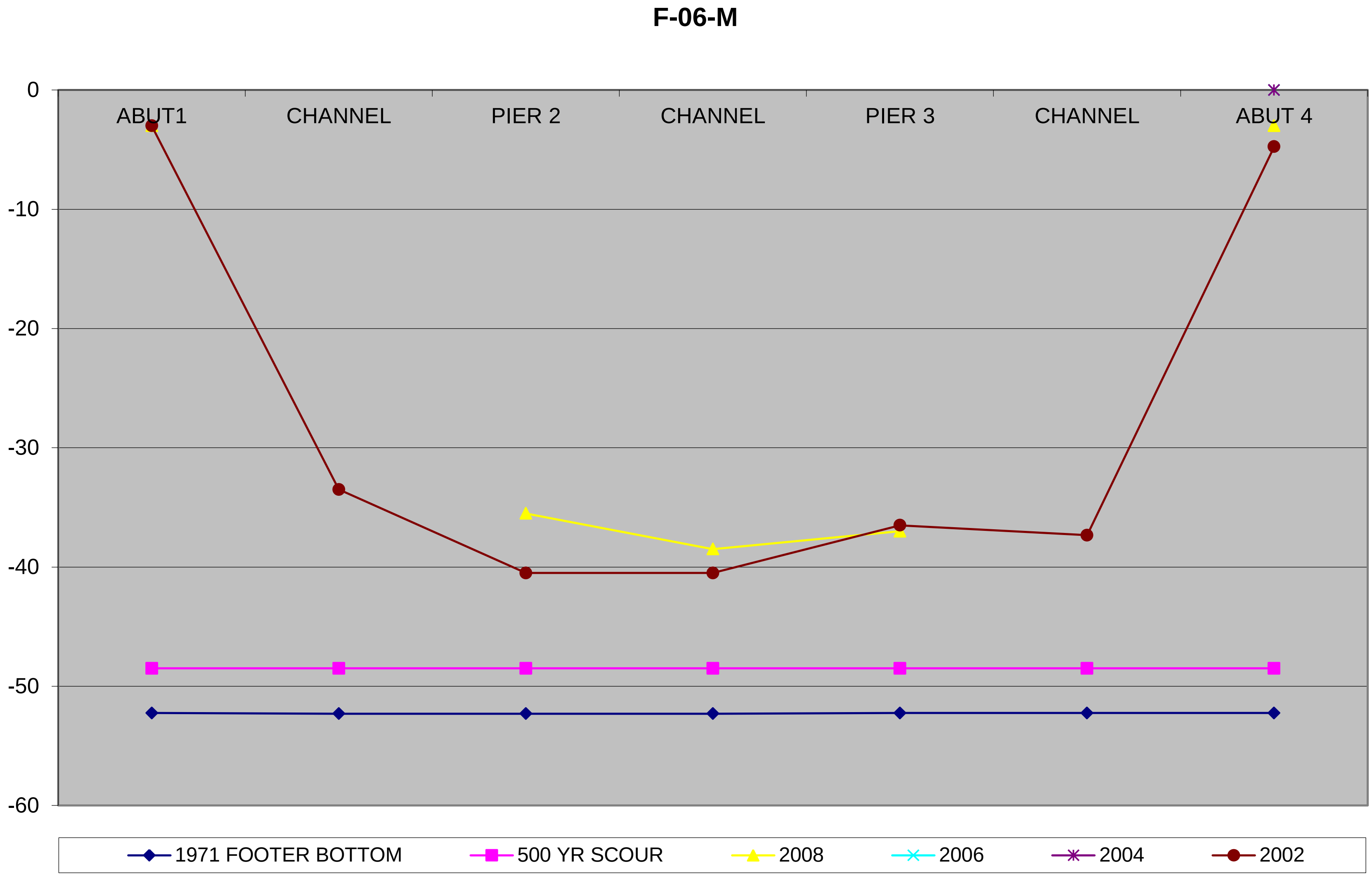
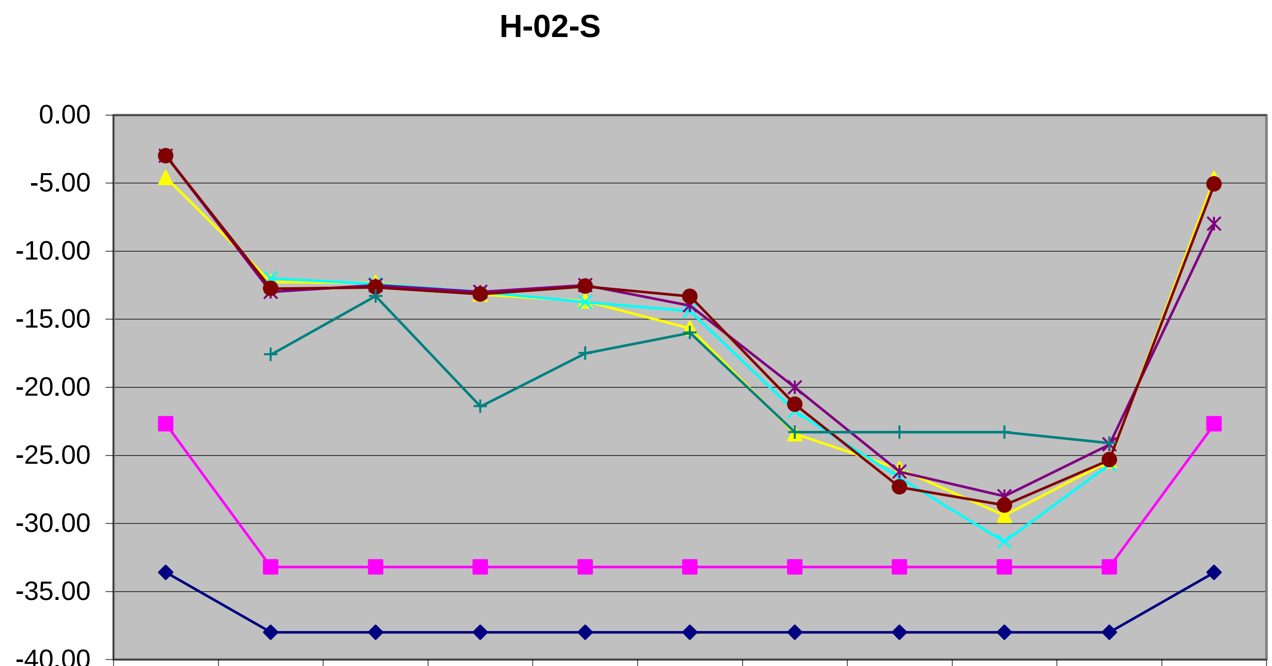


Figure C.2.2.
CDOT Scour Inspection Measurements

BRIDGE NUMBER	**F-06-M**		**Scour**	3				
HIGHWAY	**70**		**DRAINAGE AREA**	**10,000 Square miles**				
STR. TYPE	**WGC**		**STREAM**	**COLORADO RIVER**				
	ABUT1	**CHANNEL**	**PIER 2**	**CHANNEL**	**PIER 3**	**CHANNEL**	**ABUT 4**	
1971 FOOTER BOTTOM	-52.25	-52.3	-52.3	-52.3	-52.25	-52.25	-52.25	
500 YR SCOUR	-48.5	-48.5	-48.5	-48.5	-48.5	-48.5	-48.5	
2008	-3.0		-35.5	-38.5	-37.0		-3.0	
2006							0	
2004							0	
2002	-3	-33.5	-40.5	-40.5	-36.5	-37.33	-4.75	
2000	-4	-38.5	-38.5	-38.5	-38.5		-5	
1996	0	0	0	0			0	*Too Swift
1994	-2.5	-30.4	-38.4	-38.4	-39.7	-38.0	0.0	
1991	-2.7	-30.25	-38.41	-38.41	-39.16	-37.75	-2.5	
1989	-2.6	-30.3	-38.3	-38.0	-38.8	-37.7	-2.5	
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Adequate
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

Figure C.3.1. (H-02-S)
CDOT Scour Inspection Charts

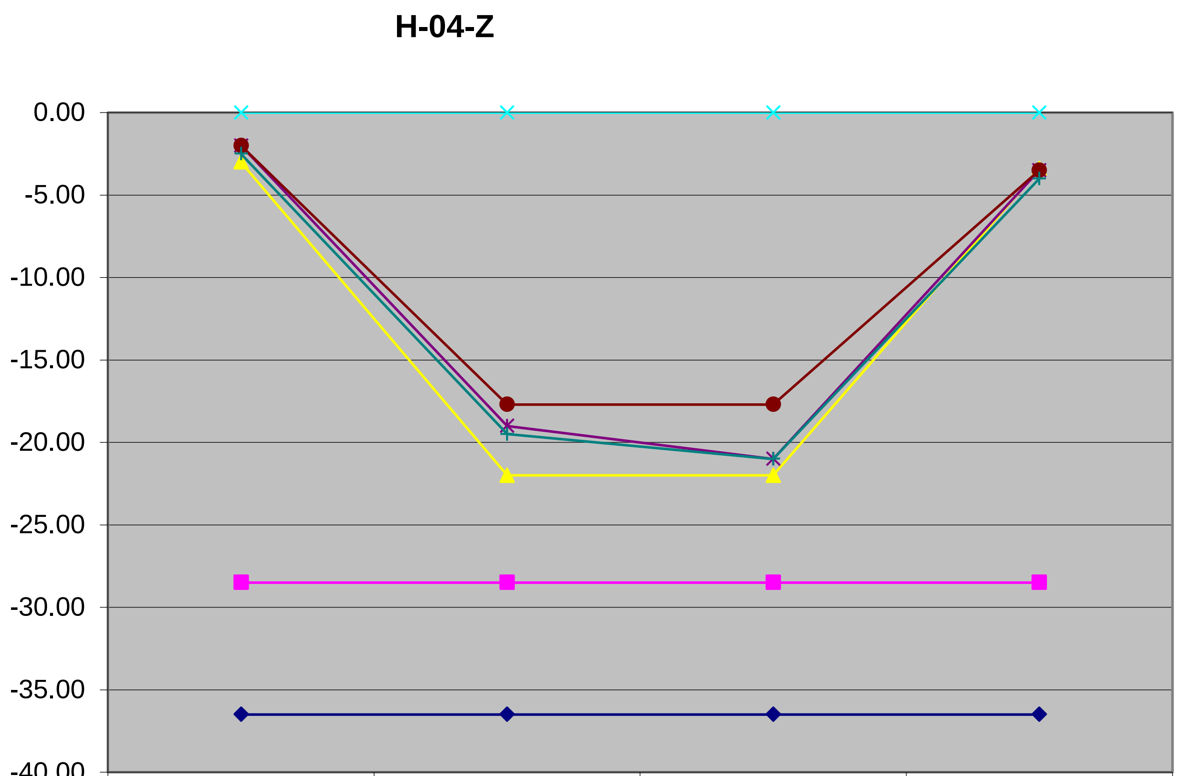


	ABUT 1	PIER 2	PIER 3	PIER 4	PIER 5	PIER 6	PIER 7	CHAN NEL	PIER 8	PIER 9	AUBT 10
1950 FOOTER BOTTOM	-33.60	-38.00	-38.00	-38.00	-38.00	-38.00	-38.00	-38.00	-38.00	-38.00	-33.60
500 YR SCOUR	-22.70	-33.20	-33.20	-33.20	-33.20	-33.20	-33.20	-33.20	-33.20	-33.20	-22.70
2008	-4.60	-12.25	-12.33	-13.17	-13.67	-15.67	-23.42	-26.00	-29.42	-25.42	-4.67
2007		-12.00	-12.41	-13.00	-13.75	-14.41	-21.75	-26.65	-31.33	-25.66	
2004	-3.00	-13.00	-12.50	-13.00	-12.50	-14.00	-20.00	-26.20	-28.00	-24.20	-8.00
2002	-3.00	-12.75	-12.66	-13.16	-12.58	-13.33	-21.25	-27.33	-28.66	-25.33	-5.08
1998		-17.60	-13.30	-21.40	-17.50	-16.00	-23.30	-23.30	-23.30	-24.10	

Figure C.3.2.
CDOT Scour Inspection Measurements

BRIDGE NUMBER	**H-02-S**		**Scour Item 113**	8 5 *3							
HIGHWAY	**34**	DRAINAGE ARE	**16750 Square Miles**								
STR. TYPE	**SDGC**	STREAM	**COLORADO RIVER**								
	ABUT 1	**PIER 2**	**PIER 3**	**PIER 4**	**PIER 5**	**PIER 6**	**PIER 7**	**CHANNEL**	**PIER 8**	**PIER 9**	**AUBT10**
1950 FOOTER BOTTOM	-33.60	-38.00	-38.00	-38.00	-38.00	-38.00	-38.00	-38.00	-38.00	-38.00	-33.60
500 YR SCOUR	-22.70	-33.20	-33.20	-33.20	-33.20	-33.20	-33.20	-33.20	-33.20	-33.20	-22.70
2008	-4.60	-12.25	-12.33	-13.17	-13.67	-15.67	-23.42	-26.00	-29.42	-25.42	-4.67
2007		-12.00	-12.41	-13.00	-13.75	-14.41	-21.75	-26.65	-31.33	-25.66	
2004	-3.00	-13.00	-12.50	-13.00	-12.50	-14.00	-20.00	-26.20	-28.00	-24.20	-8.00
2002	-3.00	-12.75	-12.66	-13.16	-12.58	-13.33	-21.25	-27.33	-28.66	-25.33	-5.08
1998		-17.60	-13.30	-21.40	-17.50	-16.00	-23.30	-23.30	-23.30	-24.10	
1996	-6.90	-15.50	-15.30	-14.70	-15.30	-15.50	-22.80	-25.30	-27.10	-25.50	-5.00
1991	-6.90	-15.50	-15.30	-14.70	-15.30	-15.30	-23.90	-23.00	-25.50	-22.90	
1989		-15.10	-17.60	-22.00	-19.60	-15.70	-17.70	-23.00	-15.50	-12.60	
1987	-3.00	-15.20	-16.50	-21.90	-19.80	-15.80	-17.80	-17.80	-15.00	-12.50	-5.00
1983	-3.00	-15.20	-17.30	-21.90	-19.60	-15.80	-17.80	-17.80	-15.00	-12.50	-5.00
1981	-3.00	-15.20	-17.20	-21.90	-19.80	-15.20	-17.80	-17.80	-15.00	-12.50	-5.00
1971	-4.80	-14.40	-18.10	-19.90	-21.80	-25.90	-28.90	-28.90	-24.30	-18.20	-4.50

Figure C.4.1. (H-04-Z)
CDOT Scour Inspection Charts

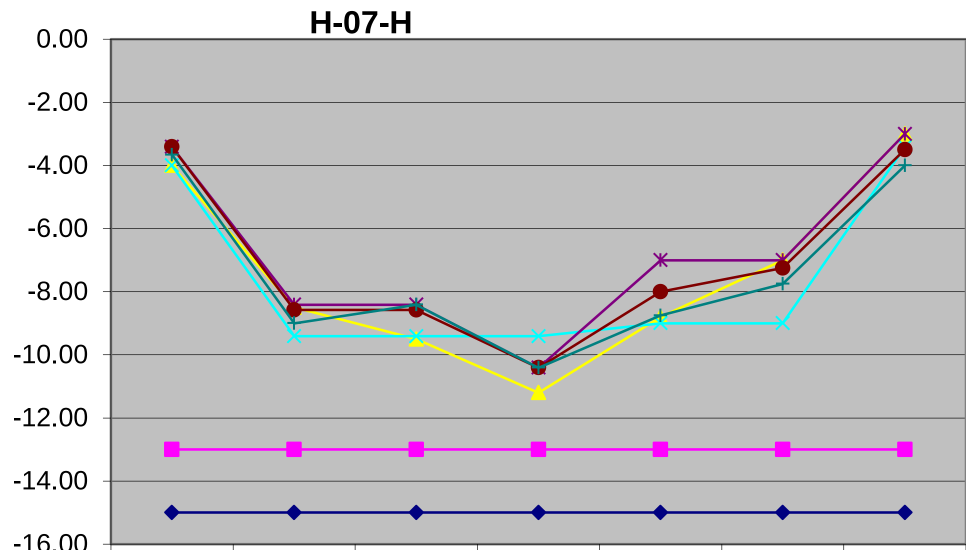


	ABUT1	CHANNEL	PIER2	ABUT3
1973 FOOTER BOTTOM	-36.50	-36.50	-36.50	-36.50
500 YR SCOUR	-28.50	-28.50	-28.50	-28.50
2006	-3.00	-22.00	-22.00	-3.41
2004	0.00	0.00	0.00	0.00
2002	-2.00	-19.00	-21.00	-3.50
1998	-2.00	-17.70	-17.70	-3.50
1996	-2.50	-19.50	-21.00	-4.00

Figure C.4.2.
CDOT Scour Inspection Measurements

BRIDGE NUMBER	**H-04-Z**	**Scour**	3	
HIGHWAY	**133**	**DRAINAGE AREA**	561 Square Miles	
STR. TYPE	**CSGC**	**STREAM**	Plateau Creek	
	ABUT1	**CHANNEL**	**PIER2**	**ABUT3**
1973 FOOTER BOTTOM	-36.50	-36.50	-36.50	-36.50
500 YR SCOUR	-28.50	-28.50	-28.50	-28.50
2006	-3.00	-22.00	-22.00	-3.41
2004	0.00	0.00	0.00	0.00
2002	-2.00	-19.00	-21.00	-3.50
1998	-2.00	-17.70	-17.70	-3.50
1996	-2.50	-19.50	-21.00	-4.00
1994	-3.00	-17.50	-19.00	-3.00
1991	-3.00	-17.50	-19.00	-3.00
1989	-3.00	-17.00	-20.40	-2.80
1987	-3.00	-17.10	-20.30	-2.10
1985	-3.60	-17.10	-20.40	-3.40
1973	-2.70	-14.00	-14.00	-3.00

Figure C.5.1. (H-07-H)
CDOT Scour Inspection Charts

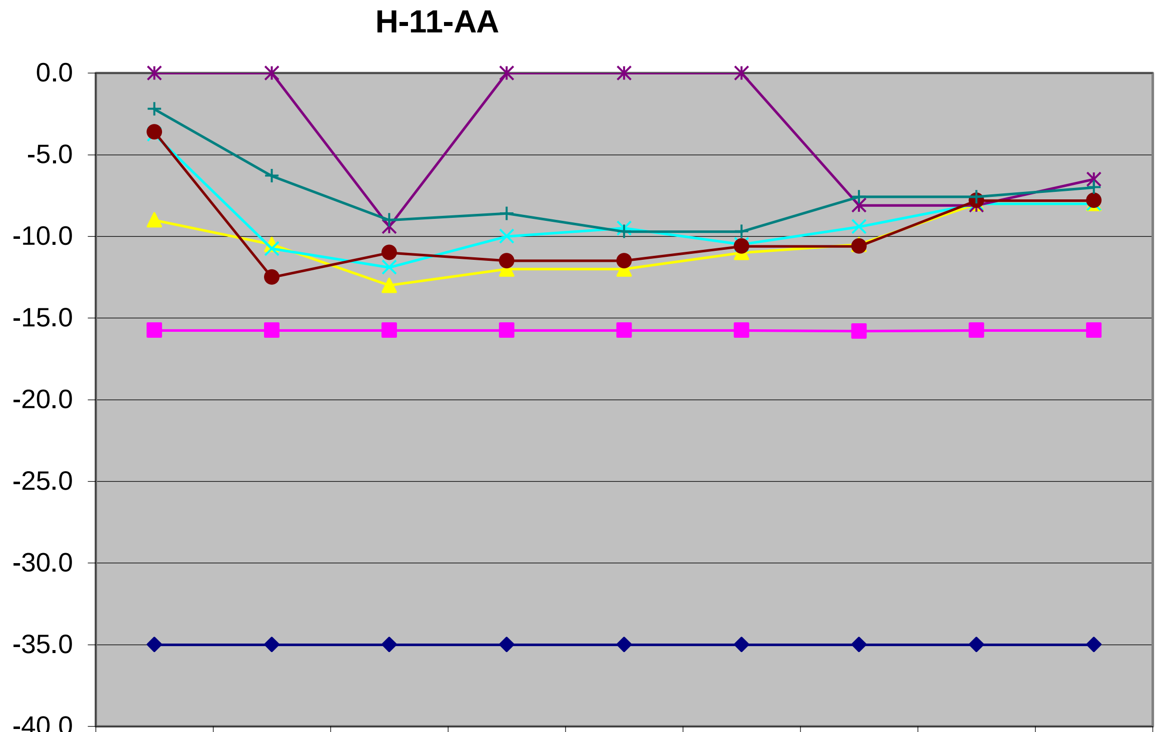


	ABUT 1	CHANNEL	PIER 2	CHANNEL	PIER 3	CHANNEL	ABUT 4
1978 GUESS FOOTING	-15.00	-15.00	-15.00	-15.00	-15.00	-15.00	-15.00
500 YR SCOUR	-13.00	-13.00	-13.00	-13.00	-13.00	-13.00	-13.00
2008	-4.00	-8.50	-9.50	-11.20	-8.80	-7.00	-3.00
2000	-4.00	-9.41	-9.41	-9.41	-9.00	-9.00	-3.41
1998	-3.41	-8.41	-8.41	-10.41	-7.00	-7.00	-3.00
1996	-3.41	-8.58	-8.58	-10.41	-8.00	-7.25	-3.50
1994	-3.66	-9.00	-8.41	-10.41	-8.75	-7.75	-4.00

Figure C.5.2.
CDOT Scour Inspection Measurements

STRUCTURE NUMBER	**H-07-H**	ITEM 113 =	**3-UNK**				
HIGHWAY	**133**	DRAINAGE AREA	**UNK**				
STR. TYPE	**CSGC**	STREAM	**EAST MUDDY CREEK**				
	ABUT 1	**CHANNEL**	**PIER 2**	**CHANNEL**	**PIER 3**	**CHANNEL**	**ABUT 4**
1978 GUESS FOOTING	-15.00	-15.00	-15.00	-15.00	-15.00	-15.00	-15.00
500 YR SCOUR	-13.00	-13.00	-13.00	-13.00	-13.00	-13.00	-13.00
2008	-4.00	-8.50	-9.50	-11.20	-8.80	-7.00	-3.00
2000	-4.00	-9.41	-9.41	-9.41	-9.00	-9.00	-3.41
1998	-3.41	-8.41	-8.41	-10.41	-7.00	-7.00	-3.00
1996	-3.41	-8.58	-8.58	-10.41	-8.00	-7.25	-3.50
1994	-3.66	-9.00	-8.41	-10.41	-8.75	-7.75	-4.00
1992	-3.41	-8.41	-8.41	-10.41	-7.00	-7.00	-3.00
1989	-3.41	-8.41	-8.41	-10.41	-7.00	-7.00	-3.00
1987	-3.16	-11.00	-11.00	-11.41	-11.41	-9.00	-3.00
1985	-3.41	-7.50	-7.50	-9.41	-9.41	-7.16	-3.10
1979	-4.00	-8.00	-8.00	-9.00	-9.00	-8.00	-4.00

Figure C.6.1. (H-11-AA)
CDOT Scour Inspection Charts



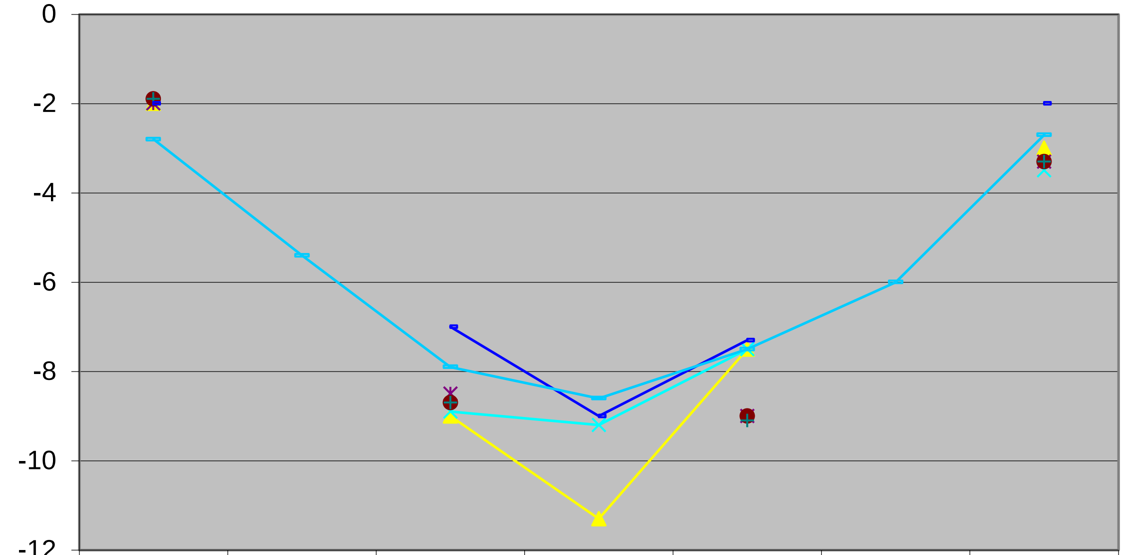
	ABUT1	PIER2	PIER3	PIER4	CHANNEL	PIER 5	CHANNEL	PIER 6	CHANNEL
1939 FOOTER BOTTOM	-35.0	-35.0	-35.0	-35.0	-35.0	-35.0	-35.0	-35.0	-35.0
500 YR SCOUR	-15.8	-15.8	-15.8	-15.8	-15.8	-15.8	-15.8	-15.8	-15.8
2005 Up Stream	-9.0	-10.5	-13.0	-12.0	-12.0	-11.0	-10.5	-8.0	-8.0
2002	-3.8	-10.8	-11.9	-10.0	-9.5	-10.5	-9.4	-8.0	-8.0
2001	0.0	0.0	-9.4	0.0	0.0	0.0	-8.1	-8.1	-6.5
1998	-3.6	-12.5	-11.0	-11.5	-11.5	-10.6	-10.6	-7.8	-7.8
1996	-2.2	-6.3	-9.0	-8.6	-9.7	-9.7	-7.6	-7.6	-7.0

Figure C.6.2.
CDOT Scour Inspection Measurements

BRIDGE NUMBER	**H-11-AA**											
HIGHWAY	300	DRAINAGE AREA	104									
STR. TYPE	TTS	STREAM	ARKANSAS									
	ABUT1	**PIER2**	**PIER3**	**PIER4**	**CHANNEL**	**PIER 5**	**CHANNEL**	**PIER 6**	**CHANNEL**	**PIER 7**	**CHANNEL**	**ABUT 8**
1939 FOOTER BOTTOM	-35.0	-35.0	-35.0	-35.0	-35.0	-35.0	-35.0	-35.0	-35.0	-35.0	-35.0	-35.0
500 YR SCOUR	-15.8	-15.8	-15.8	-15.8	-15.8	-15.8	-15.8	-15.8	-15.8	-15.8	-15.8	-15.8
2007	-7.1	-10.8	-11.0	-11.0	-11.0	-9.7	-7.5	-7.5	-7.3	-7.0	-6.4	-6.5
2006	-5.0	-6.4	-9.0	-9.0	-9.4	-10.0	-13.0	-13.0	-13.0	-9	-6.0	-6
2005 Down Stream	-5.4	-6.0	-6.4	-10.0	-10.0	-10.0	-8.0	-10.4	-7.4	-6.4	-6.4	-6.4
2005 Up Stream	-9.0	-10.5	-13.0	-12.0	-12.0	-11.0	-10.5	-8.0	-8.0	-6.4	-6.4	-6.4
2004	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	-3.8	-10.8	-11.9	-10.0	-9.5	-10.5	-9.4	-8.0	-8.0	-6.5	-6.4	-3.2
2001	0.0	0.0	-9.4	0.0	0.0	0.0	-8.1	-8.1	-6.5	-6.5	-6.5	-3.2
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	-3.6	-12.5	-11.0	-11.5	-11.5	-10.6	-10.6	-7.8	-7.8	-6.4	-6.4	-3.0
1996	-2.2	-6.3	-9.0	-8.6	-9.7	-9.7	-7.6	-7.6	-7.0	-7.0	-7.0	-3.2
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	-2.3	-6.2	-8.9	-8.6	-9.6	-9.6	-7.5	-7.5	-6.8	-6.8	-6.8	-3.5
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	-6.2	-6.4	-9.0	-10.0	-7.2	-7.2	-8.0	-8.0	-6.5	-6.5	0.0
1989	-6.5	-7.0	-7.1	-10.3	-10.3	-9.7	-9.7	-7.0	-7.0	-7.1	-7.1	-6.2
1988	-6.4	-7.0	-7.0	-10.5	-10.5	-7.0	-7.0	-7.0	-7.0	-6.4	-6.4	-4.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	-4.7	-6.9	-8.3	-10.8	-10.1	-7.1	-7.1	-6.8	-6.8	-6.1	-6.1	-4.4
1983	-1.4	-5.8	-9.7	-11.8	-10.0	-7.8	-7.8	-7.8	-6.2	-6.2	-6.2	-3.4
1981	-1.4	-5.7	-9.6	-11.6	-9.8	-7.6	-7.6	-7.8	-6.3	-6.3	-4.8	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	-3.0	-6.7	-7.6	-7.3	-11.1	-12.3	-10.4	-10.4	-7.3	-7.3	-6.6	-3.2
1973	-3.3	-6.6	-8.1	-7.5	-7.5	-10.0	-10.2	-10.2	-6.6	-6.6		-5.8
1971	-6.3	-6.7	-7.6	-7.8	-11.3	-12.1	-9.9	-9.9	-7.3	-7.3	-4.4	-3.3
1967	-6.6	-6.6	-8.0	-7.0	-7.0	-10.7	-10.2	-10.2	-7.4	-7.4		-6.7

Figure C.7.1. (H-11-U)
CDOT Scour Inspection Charts

H-11-U

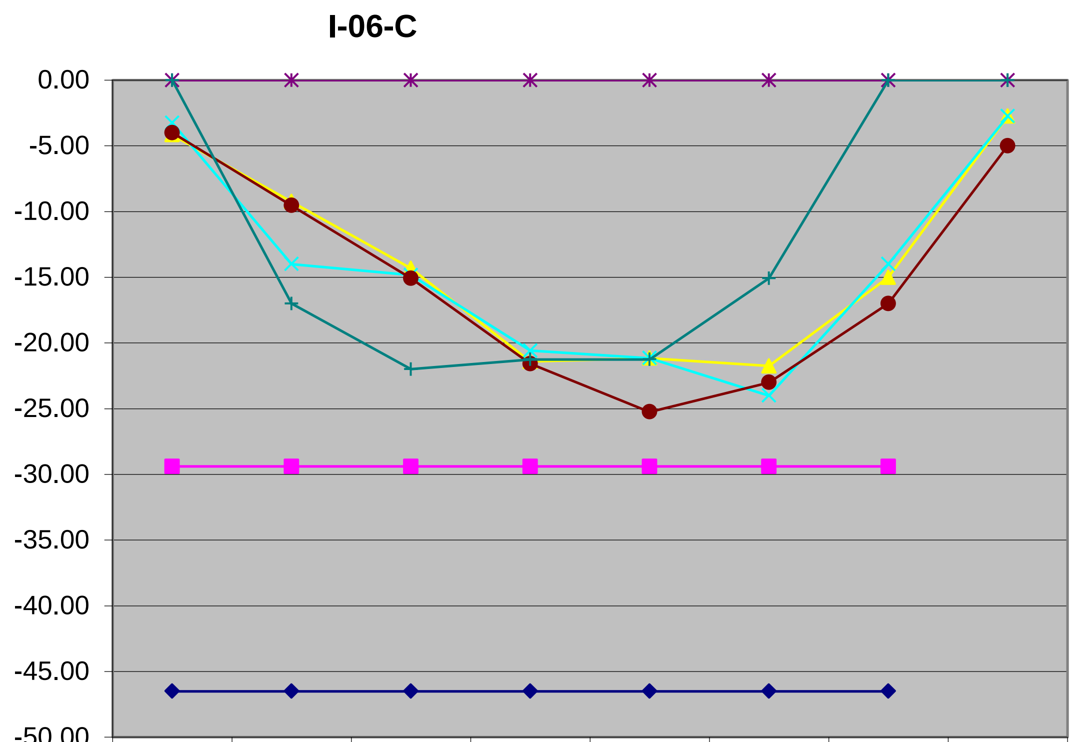


	ABUT 1	CHANNEL	PIER 2	CHANNEL	PIER 3	CHANNEL	ABUT 4
19?? FOOTING BOTTOM							
500 YR SCOUR							
2008	-2.00		-9.00	-11.30	-7.50		-3.00
2002	-2.00		-8.90	-9.20	-7.50		-3.50
1998	-2.00		-8.50		-9.00		-3.30
1996	-1.90		-8.70		-9.00		-3.30
1994	-1.90		-8.70		-9.10		-3.30
1988	-2.00		-7.00	-9.00	-7.30		-2.00
1983	-2.80	-5.40	-7.90	-8.60	-7.50	-6.00	-2.70

Figure C.7.2.
CDOT Scour Inspection Measurements

STRUCTURE	H-11-U	**Scour**	3				
HIGHWAY	300	**DRAINAGE AREA**	34.4				
STR. TYPE	TTS	**STREAM**	LAKE FORK CK				
	ABUT 1	**CHANNEL**	**PIER 2**	**CHANNEL**	**PIER 3**	**CHANNEL**	**ABUT 4**
19?? FOOTING BOTTOM							
500 YR SCOUR							
2008	-2.00		-9.00	-11.30	-7.50		-3.00
2002	-2.00		-8.90	-9.20	-7.50		-3.50
1998	-2.00		-8.50		-9.00		-3.30
1996	-1.90		-8.70		-9.00		-3.30
1994	-1.90		-8.70		-9.10		-3.30
1988	-2.00		-7.00	-9.00	-7.30		-2.00
1983	-2.80	-5.40	-7.90	-8.60	-7.50	-6.00	-2.70

Figure C.8.1. (I-06-C)
CDOT Scour Inspection Charts

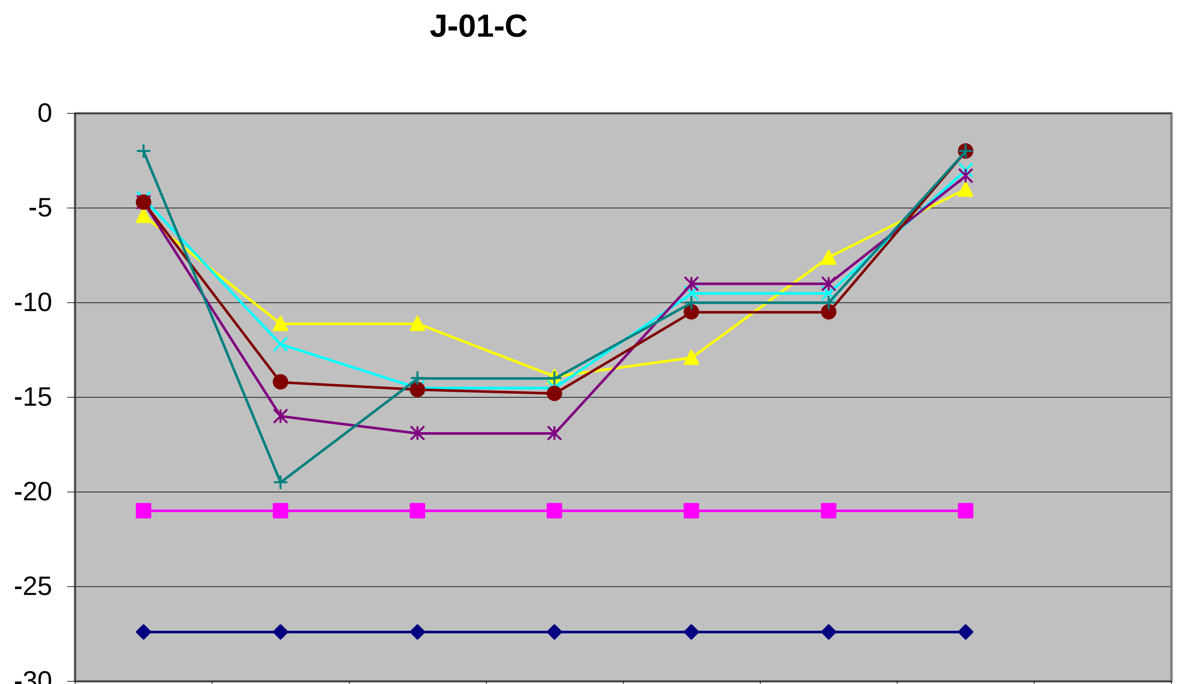


	ABUT 1	CHANNEL	PIER 2	CHANNEL	PIER 3	CHANNEL	PIER 4	ABUT 5
1984 PILE TIP ELEVATION	-46.50	-46.50	-46.50	-46.50	-46.50	-46.50	-46.50	
500 YR SCOUR	-29.40	-29.40	-29.40	-29.40	-29.40	-29.40	-29.40	
2006	-4.16	-9.25	-14.33	-21.41	-21.16	-21.75	-15.00	-2.75
2004	-3.25	-14.00	-14.83	-20.58	-21.16	-24.00	-14.00	-2.75
2002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000	-4.00	-9.54	-15.08	-21.58	-25.25	-23.00	-17.00	-5.0
1998	0.00	-17.00	-22.00	-21.25	-21.25	-15.08	0.00	0.0

Figure C.8.2.
CDOT Scour Inspection Measurements

BRIDGE NUMBER	**I-06-C**			**Scour Critical**	**3**				
HIGHWAY	**187**	DRAINAGE AREA	**600 Square Miles**						
STR. TYPE	**CIC**	STREAM	**N. FK. GUNNISON RIVER**						
	ABUT 1	**CHANNEL**	**PIER 2**	**CHANNEL**	**PIER 3**	**CHANNEL**	**PIER 4**	**ABUT 5**	
1984 PILE TIP ELEVATION	-46.50	-46.50	-46.50	-46.50	-46.50	-46.50	-46.50		
500 YR SCOUR	-29.40	-29.40	-29.40	-29.40	-29.40	-29.40	-29.40		
2006	-4.16	-9.25	-14.33	-21.41	-21.16	-21.75	-15.00	-2.75	
2004	-3.25	-14.00	-14.83	-20.58	-21.16	-24.00	-14.00	-2.75	
2002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2000	-4.00	-9.54	-15.08	-21.58	-25.25	-23.00	-17.00	-5.0	
1998	0.00	-17.00	-22.00	-21.25	-21.25	-15.08	0.00	0.0	
1996	-4.00	-9.70	-15.41	*-26.0	-22.00	-15.00	-15.00	-5.0	2 FEET SCOUR
1994	-3.00	-9.33	*-15.66	-18.00	*-21.58	-12.37	-12.37	-3.2	2 FEET SCOUR
1992	-2.58	-12.50	-15.16	-17.25	-18.00	-21.41	-11.50	-2.6	CONCRETE BLOCK
1989	-3.00	-15.41	-15.41	-17.00	-17.00	-21.41	-18.41	-3.0	
1985	-3.3	-15.0	-15.7	-17.4	-23.3	-23.3	-19.16	-1.3	
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.0	
1971	-3.3	-12.7	-16.3	-14.4	-12.5	-13.0	-13.25	-5.3	
1967	-5.2	-10.0	-15.0	-14.8	-14.7	-15.5	-16.00	-5.3	

Figure C.9.1. (J-01-C)
CDOT Scour Inspection Charts



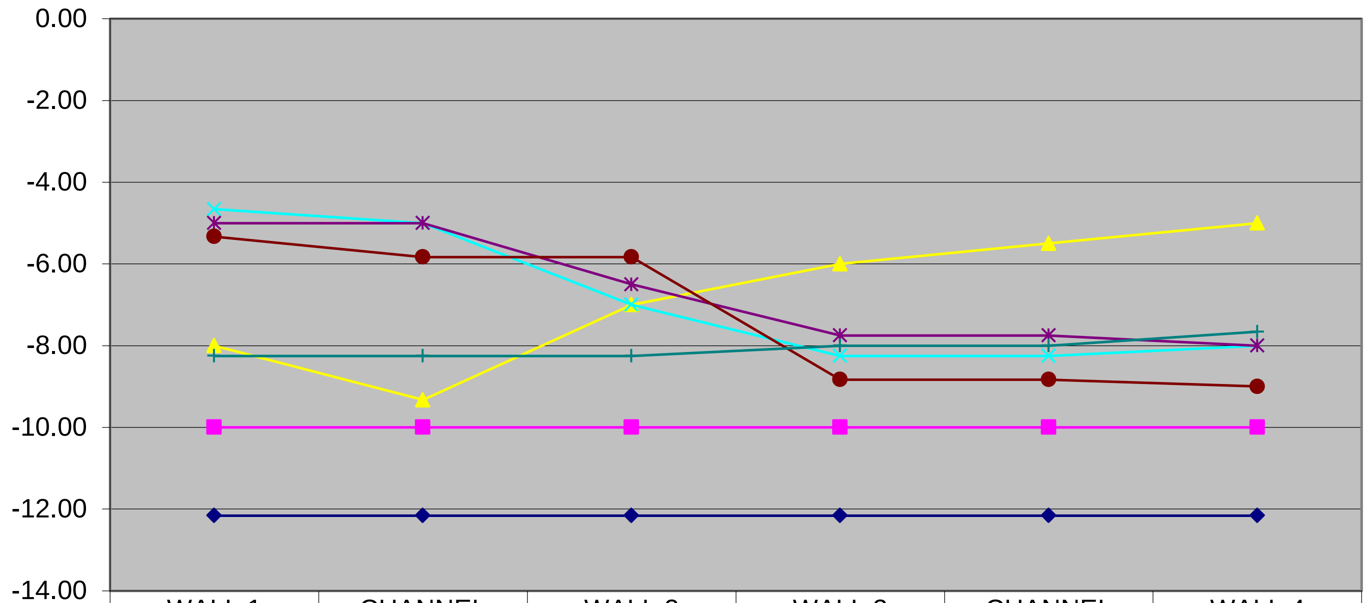
	Abut1	Pier2	Pier3	Channel	Pier 4	Channel	Abut 5	
1957 FOOTINGS BOTTOM	-27.4	-27.4	-27.4	-27.4	-27.4	-27.4	-27.4	
500 YR SCOUR	-21	-21	-21	-21	-21	-21	-21	
2004	-5.4	-11.11	-11.11	-13.9	-12.9	-7.6	-4	
2000	-4.5	-12.2	-14.5	-14.5	-9.5	-9.5	-3	
1998	-4.7	-16	-16.9	-16.9	-9	-9	-3.3	
1996	-4.7	-14.2	-14.6	-14.8	-10.5	-10.5	-2	
1994	-2	-19.5	-14	-14	-10	-10	-2	

Figure C.9.2.
CDOT Scour Inspection Measurements

Bridge Number	J-01-C		**Scour**	3			
Highway	141		**Drainage area**	1,321 Sq. Miles			
Span/type	4 CIC		**Stream**	Dolores River			
	Abut1	**Pier2**	**Pier3**	**Channel**	**Pier 4**	**Channel**	**Abut 5**
1957 FOOTINGS BOTTOM	-27.4	-27.4	-27.4	-27.4	-27.4	-27.4	-27.4
500 YR SCOUR	-21	-21	-21	-21	-21	-21	-21
2006	0	0	0	0	0	0	0
2004	-5.4	-11.11	-11.11	-13.9	-12.9	-7.6	-4
2000	-4.5	-12.2	-14.5	-14.5	-9.5	-9.5	-3
1998	-4.7	-16	-16.9	-16.9	-9	-9	-3.3
1996	-4.7	-14.2	-14.6	-14.8	-10.5	-10.5	-2
1994	-2	-19.5	-14	-14	-10	-10	-2
1992	-2	-19.2	-14	-14	-10	-10	-2
1991	-2	-16.9	-13.3	-15	-10.6	-8	-2
1988	-4.3	-17	-13	-15	-9.6	-8.2	-1.8
1987	-4.3	-17	-13	-15	-9.6	-8.1	-1.7
1985	-2.1	-17.1	-12.9	-11.3	-11.2	-9.3	-1.9
1981	-1	-11.3	-11.8	-11.8	-17.7	-12.6	-1.4
1971	-1.4	-15.8	-13.2	-13.2	-13	-13	-3.4
1967	-1.6	-13.2	-12.8	-12.8	-14	-10.8	-2.3

Figure C.10.1. (J-01-D)
CDOT Scour Inspection Charts

J-01-D



	WALL 1	CHANNEL	WALL 2	WALL 3	CHANNEL	WALL 4
1955 GUESS FOOTING	-12.16	-12.16	-12.16	-12.16	-12.16	-12.16
500 YR SCOUR	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
2008	-8.00	-9.33	-7.00	-6.00	-5.50	-5.00
2004	-4.66	-5.00	-7.00	-8.25	-8.25	-8.00
2000	-5.00	-5.00	-6.50	-7.75	-7.75	-8.00
1998	-5.33	-5.83	-5.83	-8.83	-8.83	-9.00
1996	-8.25	-8.25	-8.25	-8.00	-8.00	-7.66

Figure C.10.2.

CDOT Scour Inspection Measurements

STRUCTURE NUMBER	J-01-D	**ITEM 113 =**	UNK			
HIGHWAY	141	**DRAINAGE AREA**	10 Square Miles			
STR. TYPE	SSM	**STREAM**	JOHN BROWN CREEK			
	WALL 1	**CHANNEL**	**WALL 2**	**WALL 3**	**CHANNEL**	**WALL 4**
1955 GUESS FOOTING	-12.16	-12.16	-12.16	-12.16	-12.16	-12.16
500 YR SCOUR	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
2008	-8.00	-9.33	-7.00	-6.00	-5.50	-5.00
2004	-4.66	-5.00	-7.00	-8.25	-8.25	-8.00
2000	-5.00	-5.00	-6.50	-7.75	-7.75	-8.00
1998	-5.33	-5.83	-5.83	-8.83	-8.83	-9.00
1996	-8.25	-8.25	-8.25	-8.00	-8.00	-7.66
1994	-7.08	-9.08	-9.08	-7.58	-9.41	-8.00
1992	-7.00	-8.83	-7.58	-8.16	-9.25	-7.91
1990	-7.58	-8.66	-8.00	-8.00	9.08	-8.08
1988	-8.25	-8.25	-6.70	-6.66	-6.66	-7.08
1987	-6.50	-6.50	-6.66	-7.75	-7.75	-8.00
1985	-8.16	-8.16	-7.00	-6.33	-7.16	-6.66
1981	-7.58	-7.58	-8.25	-7.66	-7.66	-8.41
1975	-8.66	-8.66	-8.75	-8.75	-9.00	-9.00
1973	-6.58	-9.58	-9.00	-9.00	-6.58	-6.58
1971	-6.25	-6.25	-7.33	-7.33	-6.66	-6.66
1967	-8.16	-8.16	-8.16	-8.16	-8.16	-8.16

Figure C.11.1. (J-09-AB)
CDOT Scour Inspection Charts

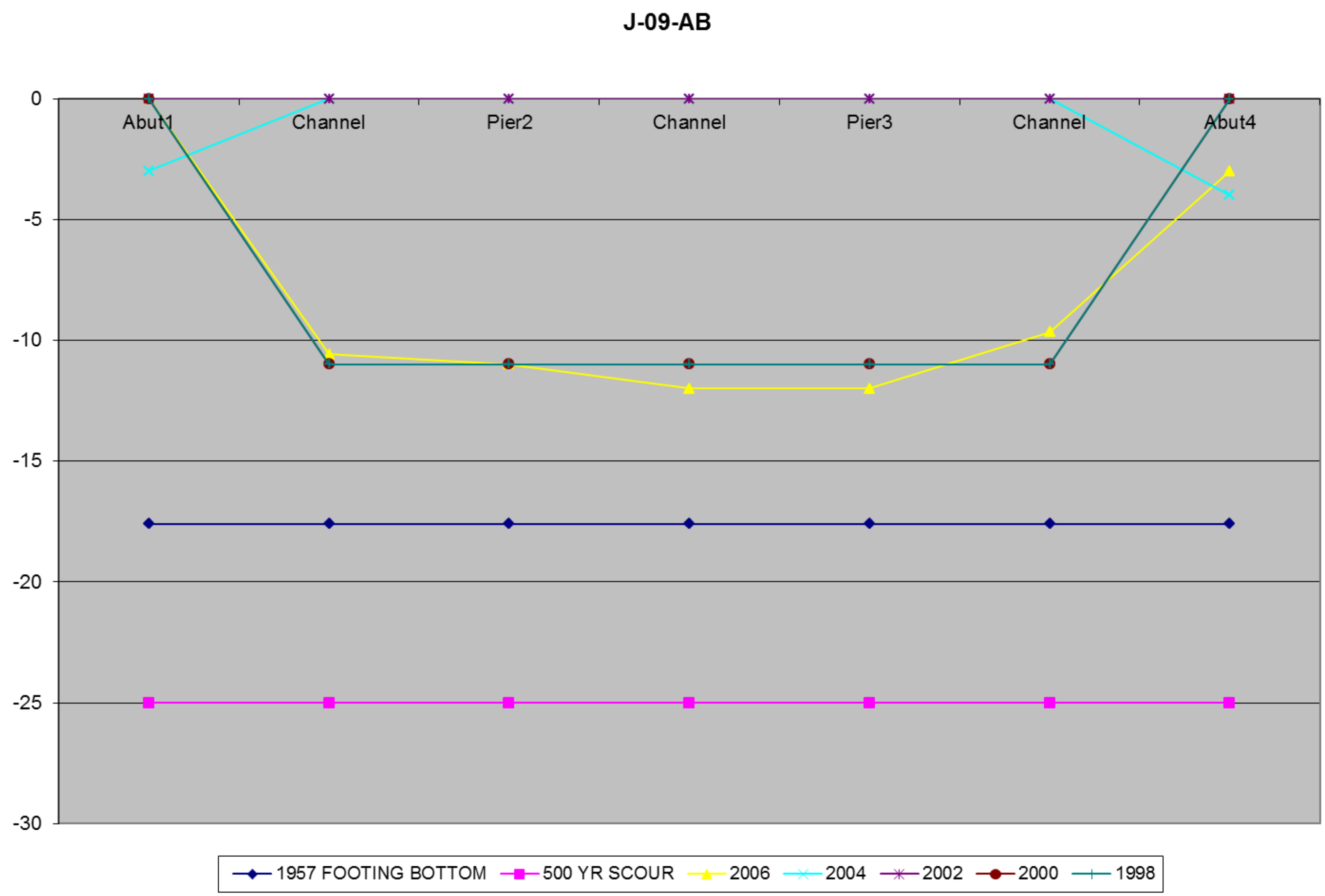


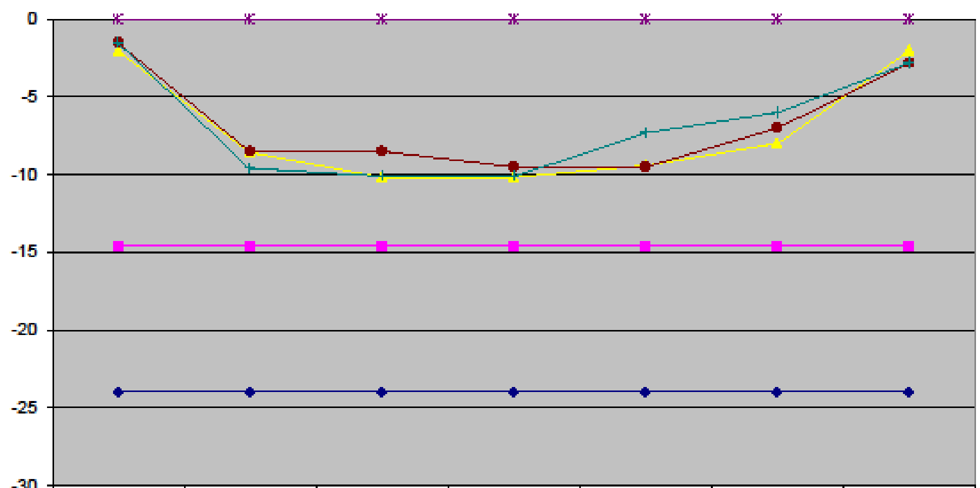
Figure C.11.2.
CDOT Scour Inspection Measurements

J-09-AB			**Scour Critical**	**3**		
50		Drainage area	**1023 Sq. Miles**			
3 CIC		Stream	**GUNNISON RIVER**			

Abut1	Channel	Pier2	Channel	Pier3	Channel	Abut4
-17.6	-17.6	-17.6	-17.6	-17.6	-17.6	-17.6
-25	-25	-25	-25	-25	-25	-25
0	-10.58	-11	-12	-12	-9.66	-3
-3	0	0	0	0	0	-4
0	0	0	0	0	0	0
0	-11	-11	-11	-11	-11	0
0	-11	-11	-11	-11	-11	0
-2.41	-8.66	-10.41	-11.08	-11	8.66	-3.41
-2.5	-8.8	-10.5	-11.1	-11	-8.8	-3.5
-2.9	-9.1	-10.7	-11.5	-11.5	-9	-4.3
-3	-13.7	-13.7	-15	-9	-9	-3
-2	-9.6	-11	-11	-11	-9	-2
-2.3	-10.5	-10.5	-10.5	-10.5	-10.5	-1.5
-2.2	-9.4	-10.4	-10.6	-9.8	-9	-2
-2.2	-9.4	-11.2	-10.6	-10.4	-9	-2

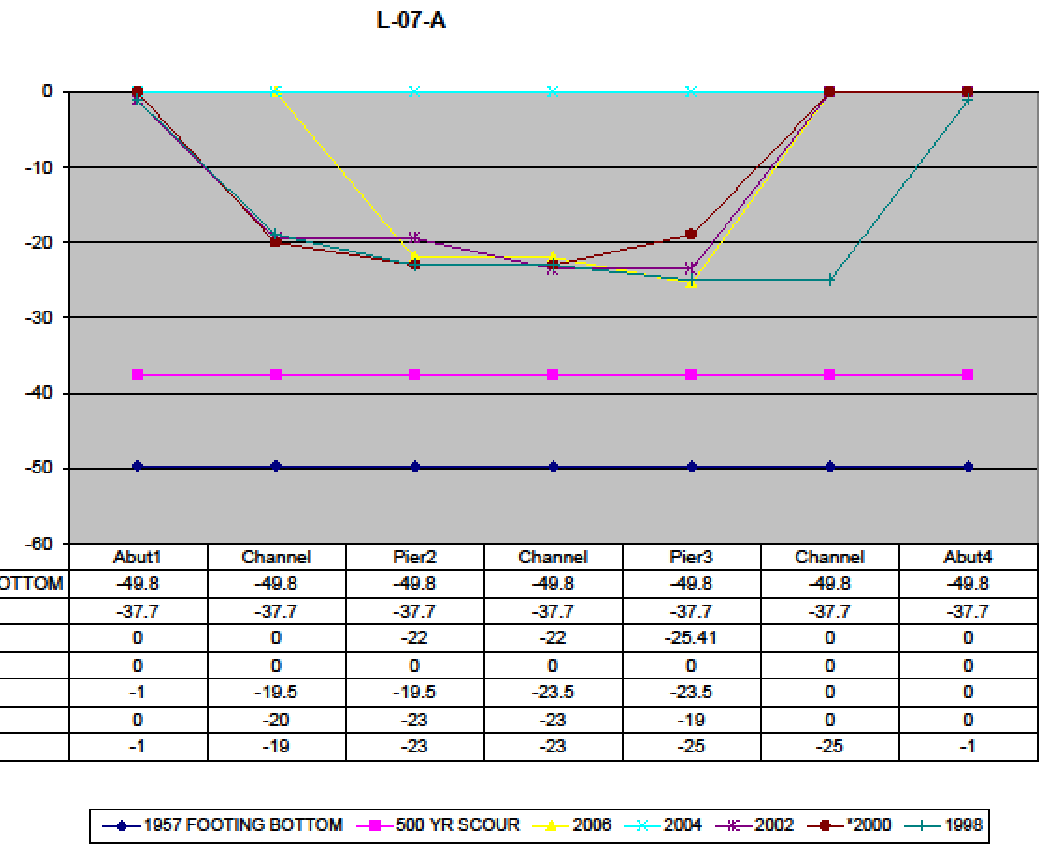
Figure C.12.1. (K-08-D)
CDOT Scour Inspection Charts

K-08-D



	Abut1	Channel	Pier2	Channel	Pier3	Channel	Abut4
1968 FOOTING BOTTOM	-24	-24	-24	-24	-24	-24	-24
500 YR SCOUR	-14.6	-14.6	-14.6	-14.6	-14.6	-14.6	-14.6
2006	-2	-8.58	-10.16	-10.16	-9.41	-8	-2
2004	0	0	0	0	0	0	0
2002	0	0	0	0	0	0	0
2000	-1.5	-8.5	-8.5	-9.5	-9.5	-7	-2.8
1998	-1.5	-9.6	-10.1	-10.1	-7.3	-6	-2.8

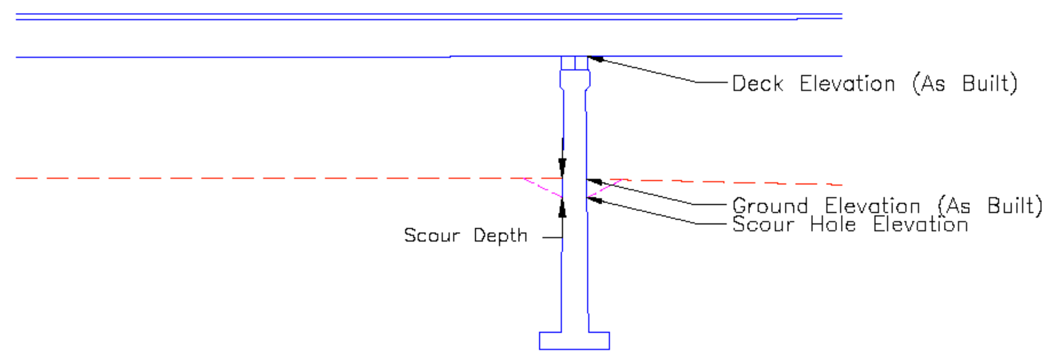
Figure C.13.1. (L-07-A)



	Abut1	Channel	Pier2	Channel	Pier3	Channel	Abut4
1957 FOOTING BOTTOM	-49.8	-49.8	-49.8	-49.8	-49.8	-49.8	-49.8
500 YR SCOUR	-37.7	-37.7	-37.7	-37.7	-37.7	-37.7	-37.7
2006	0	0	-22	-22	-25.41	0	0
2004	0	0	0	0	0	0	0
2002	-1	-19.5	-19.5	-23.5	-23.5	0	0
*2000	0	-20	-23	-23	-19	0	0
1998	-1	-19	-23	-23	-25	-25	-1

APPENDIX D – MEASURED PIER SCOUR METHODOLOGY

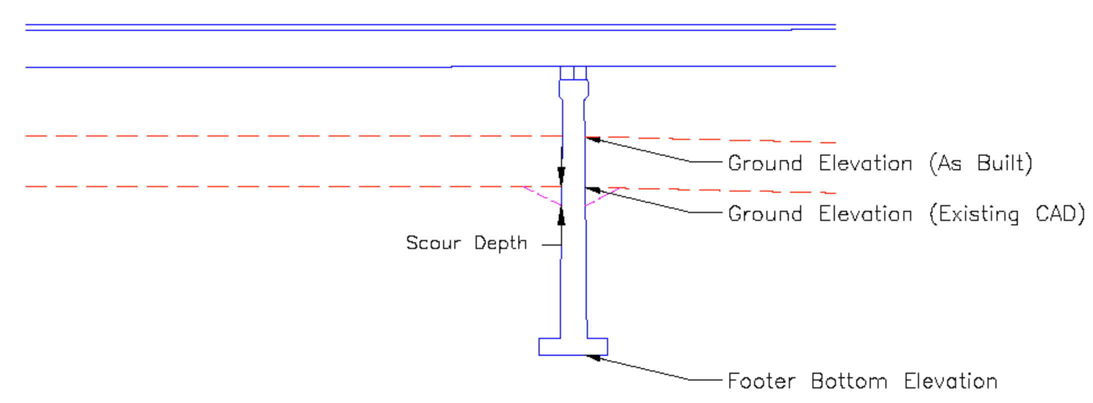
Figure D.1.
Measured Pier Scour Method 1



Method 1

Deck Elevation – Largest Scour Depth (from CDOT Scour Chart) = Elevation of Scour Hole Bottom
Ground Elevation – Elevation of Scour Hole = **Scour Depth**

Figure D.2.
Measured Pier Scour Method 2



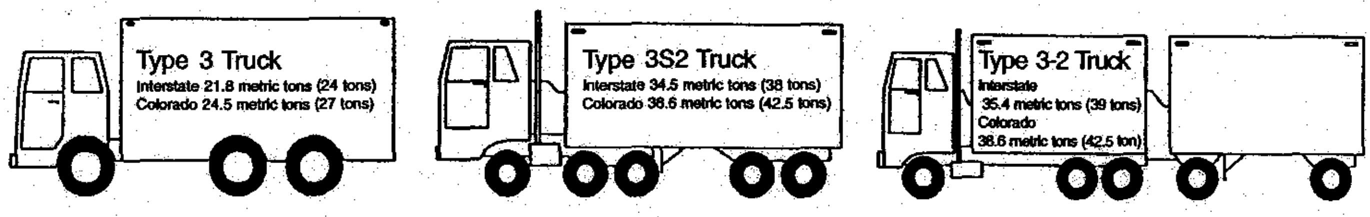
Method 2

[Ground Elevation (from As Built) – Footer Bottom Elevation (from As Built)] – [Ground Elevation (from Existing CAD) – Footer Bottom Elevation (from Existing CAD)] = **Scour Depth**

APPENDIX E – EXISTING BRIDGE PLANS & SUBSURFACE INFORMATION

COLORADO DEPARTMENT OF TRANSPORTATION **LOAD FACTOR RATING SUMMARY**	Structure # C-09-AR State highway # 131
Rated using Asphalt thickness: 100 mm (4 in.) ☒ Colorado legal loads ☐ Interstate legal loads	Batch I.D. VIRTIS BID #1301 Structure type CICK Parallel structure #

Structural member	INTERIOR GIRDER G01	DECK SLAB		
	Metric tons (Tons)			
Inventory	28 (31)	31 (35)	( )	( )
Operating	47 (52)	53 (59)	( )	( )
Type 3 truck	( )	( )	( )	( )
Type 3S2 truck	( )	( )	( )	( )
Type 3-2 truck	( )	( )	( )	( )
Permit truck	104 (115)	( )	( )	( )



Type 3 Truck	Type 3S2 Truck	Type 3-2 Truck
____ Metric tons (____ Tons)	____ Metric tons (____ Tons)	____ Metric tons (____ Tons)

Comments

Color Code: WHITE

Rated by	Date	Checked by	Date
MAC HASAN, PE, SE	6/8/04	Ali Harajli, PE I	9/14/04

Previous editions are obsolete and may not be used

CDOT Form #1187a 1/95

GENERAL NOTES:

1) All work ~~shall be~~ [WAS] done according to the Standard Specifications of the Division of Highways, State of Colorado, applicable to the Project.

2) All concrete surfaces marked with the symbol *f* as shown on Dwg. No. B-11 ~~shall~~ [DID] receive a Class 2 surface finish.

3) Soundings and depth of footings ~~are~~ [WERE] in accordance with the best available data. When different conditions ~~are~~ [WERE] encountered, the Bridge Engineer will inspect and determine if redesign is necessary.

4) When excavating for footings, the final six inches in depth ~~shall be~~ [WAS] done by hand labor methods.

5) Footings in rock ~~shall~~ [WAS] not ~~be~~ formed but ~~shall be~~ placed against undisturbed rock.

6) For details of structure excavation and structure backfill, See Standard M-206-AB.

7) Table shows minimum lap for common bar sizes:

Bar Size No.	4	5	6	7	8	9	10	11
Splice Length	1'-0"	1'-2"	1'-8"	2'-3"	3'-0"	3'-10"	4'-10"	6'-0"

8) Location of all construction joints ~~shall be~~ [WAS] approved by the Engineer.

9) All concrete chamfers ~~shall be~~ [WERE] $\frac{3}{4}$ inch unless otherwise noted.

10) Expansion joint material ~~shall~~ [DID] meet the A.A.S.H.T.O. Specification M213-65 and ~~shall be~~ [WAS] included in the payment for Item 601.

11) All structural steel not otherwise noted ~~shall be~~ [WAS] A.A.S.H.T.O. Specification M-183 (A.S.T.M. A36).

12) All structural steel not otherwise noted [WAS] ~~shall be~~ painted in accordance with Section 509 for Spruce Green Paint.

13) All bolts ~~shall be~~ [WERE] $\frac{3}{4}$" diameter, high strength, unless otherwise noted.

14) No welding of any kind ~~shall be~~ [WAS] permitted on the flanges of steel girders unless specifically called for on the plans.

15) Grade 60 reinforcing steel required for #5 bars and larger. Grade 40 or Grade 60 ~~may be~~ [WERE] furnished for #4 bars.

16) Abbreviations:
E.F. = Each Face
N.F. = Near Face
F.F. = Far Face

Cross Reference
Drawing Number
Section or Detail
Identification

17) Concrete deck ~~shall~~ [DID] receive a transverse fiber broom finish.

LOADING DATA:

Liveload: A.A.S.H.T.O. HS-20-44

Deadload: Assumes 25 lbs. per sq. ft. for bituminous pavement.

DESIGN DATA: YR. OF CONSTR. = 1976

A.A.S.H.T.O 1973 Unit Stresses, except as noted:

Reinforcing Steel:
#5 bars & larger — f_s = 24,000 psi [Fy=60] except f_s = 20,000 psi in transverse deck slab. [Fy=40 or =60 ksi]
#4 bars — f_s = 20,000 psi

Structural Steel:
A36 — Fs = 20,000 lbs. per sq. in.
A572 Grade 50 — Fs = 27,000 lbs. per sq. in.

Concrete: Fc = 1,200 lbs. per sq. in.
n = 10
F'_c = 3000 PSI

FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	RS 0131 (7)	6	

REVISIONS

AS CONSTRUCTED
NO REVISIONS REVISED 6-1-77 VOID

INDEX OF DRAWINGS

BOOK 1

SUMMARY OF QUANTITIES

	Item No.	Description	Unit	Super-structure	Abut. No. 1	Pier No. 2	Pier No. 3	Abut. No. 4	Total	
	202	Removal of Bridge	Each						1	
	206	Structure Excavation	Cu. Yd.		25	70	70	25	190	
	206	Structure Backfill (Class 2)	Cu. Yd.		20	45	45	20	130	
	403	Hot Bituminous Pavement (Gr E) (H - A)	Ton	58					58	
1	502	Steel Piling (HP 12 × 53)	Lin. Ft.		~~80~~ 81.1	~~70~~ 59.1	~~70~~ 59.8	~~80~~ 83.0	~~300~~ 287	Page 25
	502	Reinforcing Tip	Each		4	6	6	4	20	
2	506	Riprap	Cu. Yd.		270			270	~~540~~ 516	Page 29
3	509	Structural Steel	Lb.	48,600		1,130	1,130		50,860	
	509	Structural Steel (Galvanized)	Lb.	14,050					14,050	
	601	Concrete Class A (Bridge)	Cu. Yd.		12.1	47.7	47.7	12.1	119.6	
	601	Concrete Class D (Bridge)	Cu. Yd.	165.2					165.2	
	602	Reinforcing Steel	Lb.	41,450	2,500	1,770	1,770	2,500	49,990	
	606	Guard Rail Type 3A	Lin. Ft.	275					275	

1. HPS 10 × 57 may be used in lieu of HP 12 × 53.
2. 9" stone size.
3. Includes 8 sq. ft. Elastomeric Bearing Pad Material.

BRIDGE DESCRIPTION

3 Simple Spans (32'-0", 45'-0", 32'-0")
Concrete Slab and I-beam Bridge
Over Yampa River
44'-0" Roadway curb to curb, 90° skew,
1'-3" Curbs with Bridge Rail Type 3.

Sta 223+94.25 to 225+05.75
South of Steamboat Springs
Sect. 16, T. 5 N., R. 84 W.

DIVISION OF HIGHWAYS

IHLENFELDT, PETERSON & HANEY, INC.
STRUCTURAL ENGINEERS

GENERAL INFORMATION
SUMMARY OF QUANTITIES

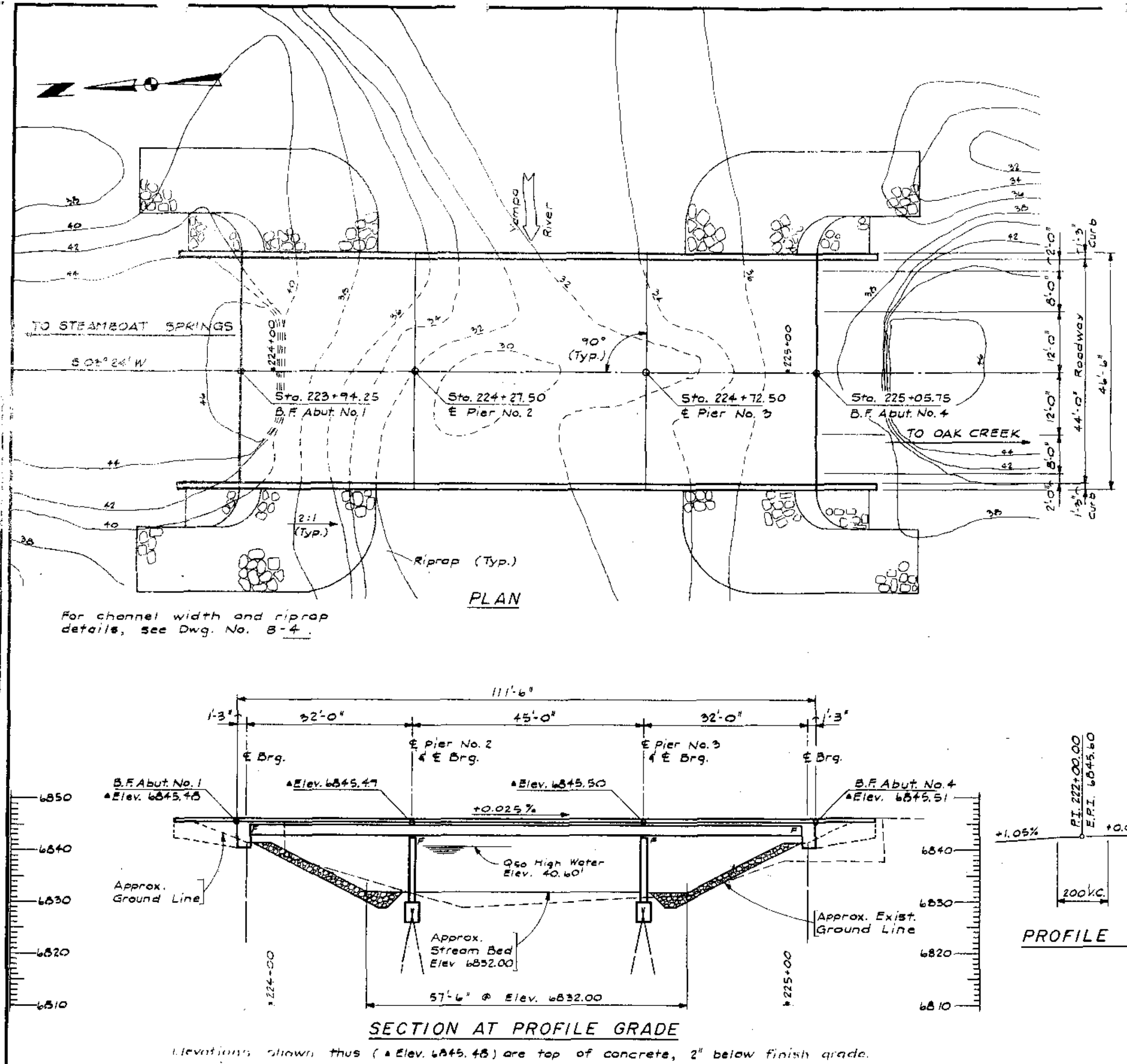
Designer B. Riddell / LDP — Structure Numbers: C-9-AR
Detailer B. Walton
Drawing Number B 1 of 15 Drawings

Revision Dates (Preliminary Stage Only)

FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	RS 0131(7)	7	

REVISIONS

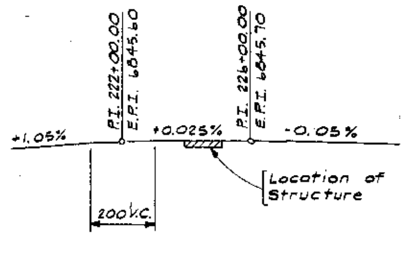
AS CONSTRUCTED
NO REVISIONS 6-1-77 REVISED VOID



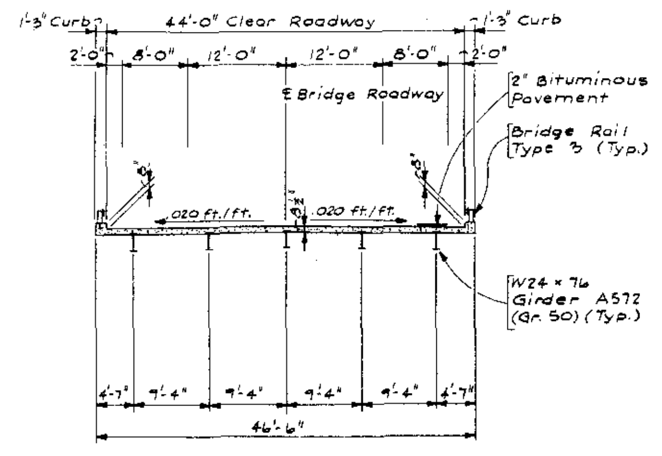
PLAN

SECTION AT PROFILE GRADE

Elevations shown thus (▲Elev. 6845.48) are top of concrete, 2" below finish grade.



PROFILE GRADE DATA



TYPICAL SECTION

NOTES:

1)

Pile Size	Location	Est. Tip Elev.
HP 12 × 53	Abut No. 1	6822
HP 12 × 53	Pier No. 2	6816
HP 12 × 53	Pier No. 3	6816
HP 12 × 53	Abut No. 4	6822

All piles are end bearing.

2) Live Loading HS-20-44.

3) Q_{50} = 4500 c.f.s., Drainage Area = 399 sq. mi. Based on U.S.G.S. stream gage analysis and U.S.G.S. Regional analysis.

DIVISION OF HIGHWAYS

IHLENFELDT, PETERSON & HANEY, INC.
STRUCTURAL ENGINEERS

GENERAL LAYOUT

Designer	B. Riddell / IDH	Structure Numbers	C-9-AR
Detailer	B. Walton		

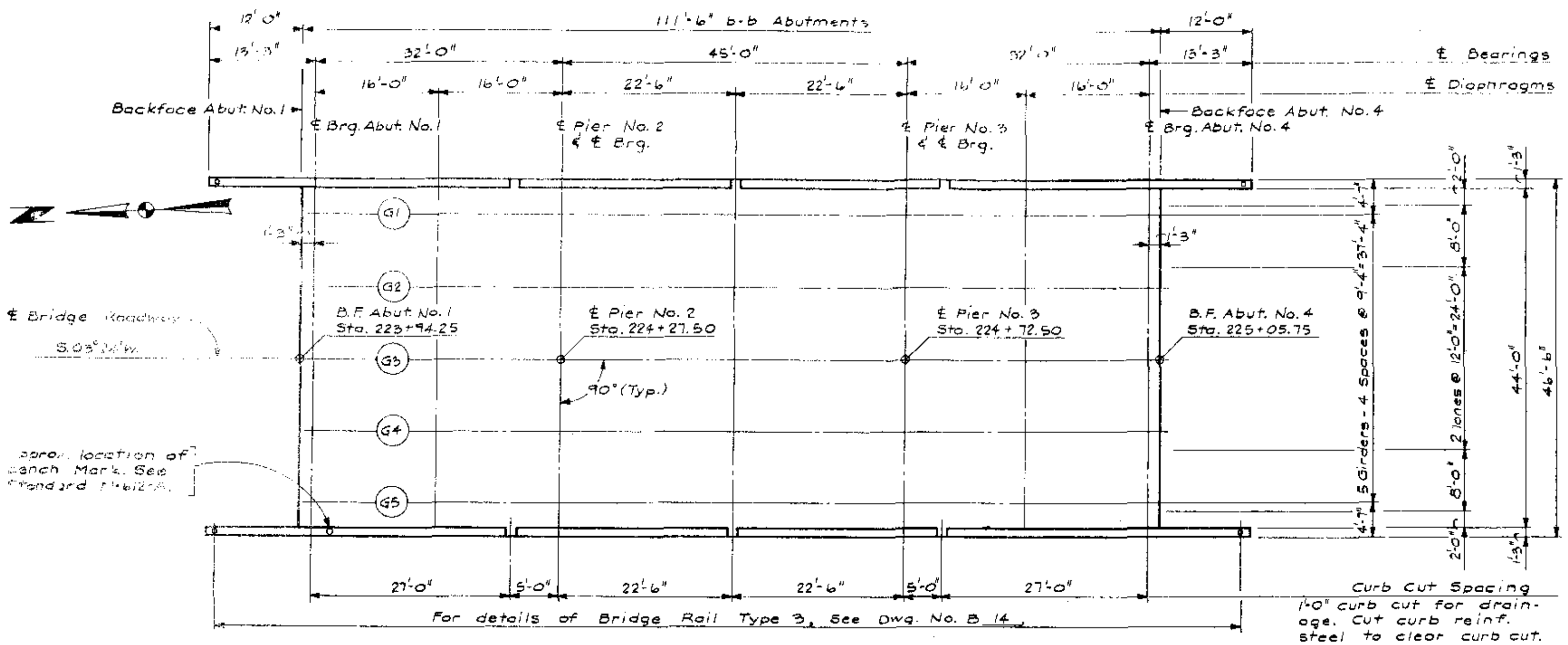
Drawing Number B 2 of 15 Drawings

FEDERAL ROAD REGION NO	DISTRICT	PROJ. NO	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	RS 0131 (7)	11	

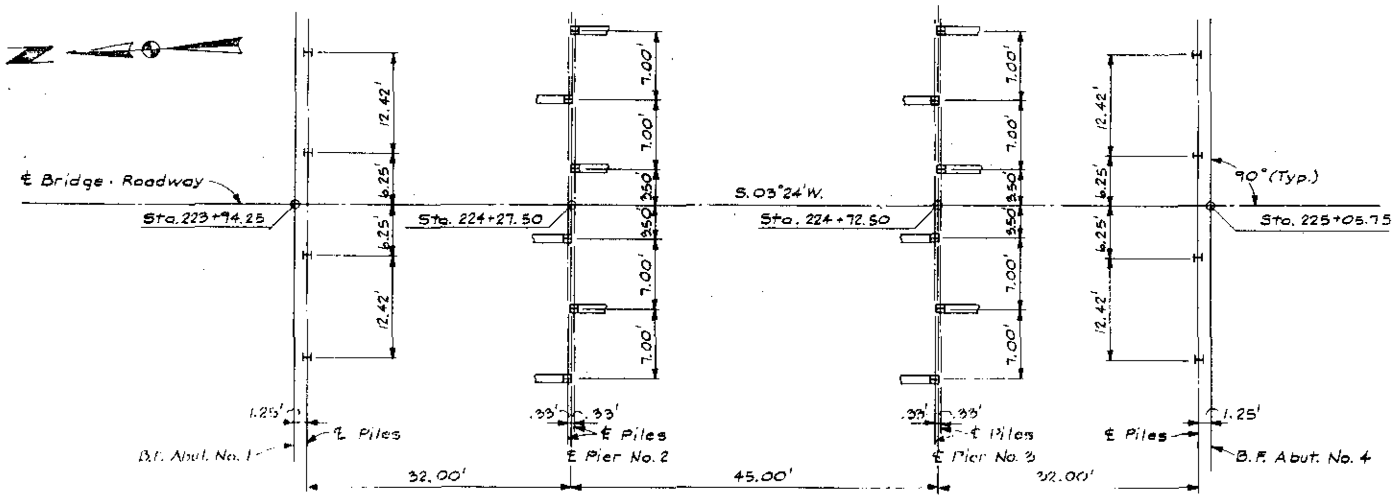
REVISIONS

AS CONSTRUCTED

NO REVISIONS | REVISED 6-1-77 | VOID



CONSTRUCTION LAYOUT



PILING LAYOUT

NOTES:

1. Piles shown thus ( ) ~~shall be~~ WERE battered 2:12.
2. All piling dimensions are at bottom of concrete.
3. Abutment piling ~~shall be~~ WAS end bearing HP 12×53, Maximum Pile Load = 53.5 T.
   Pier piling ~~shall be~~ WAS end bearing HP 12×53, Maximum Pile Load = 70.0 T.
4. Curb cut locations ~~may be~~ WAS adjusted by the Engineer to miss Rail Post locations.

DIVISION OF HIGHWAYS

IHLENFELDT, PETERSON & HANEY, INC.
STRUCTURAL ENGINEERS

PILING AND CONSTRUCTION LAYOUTS

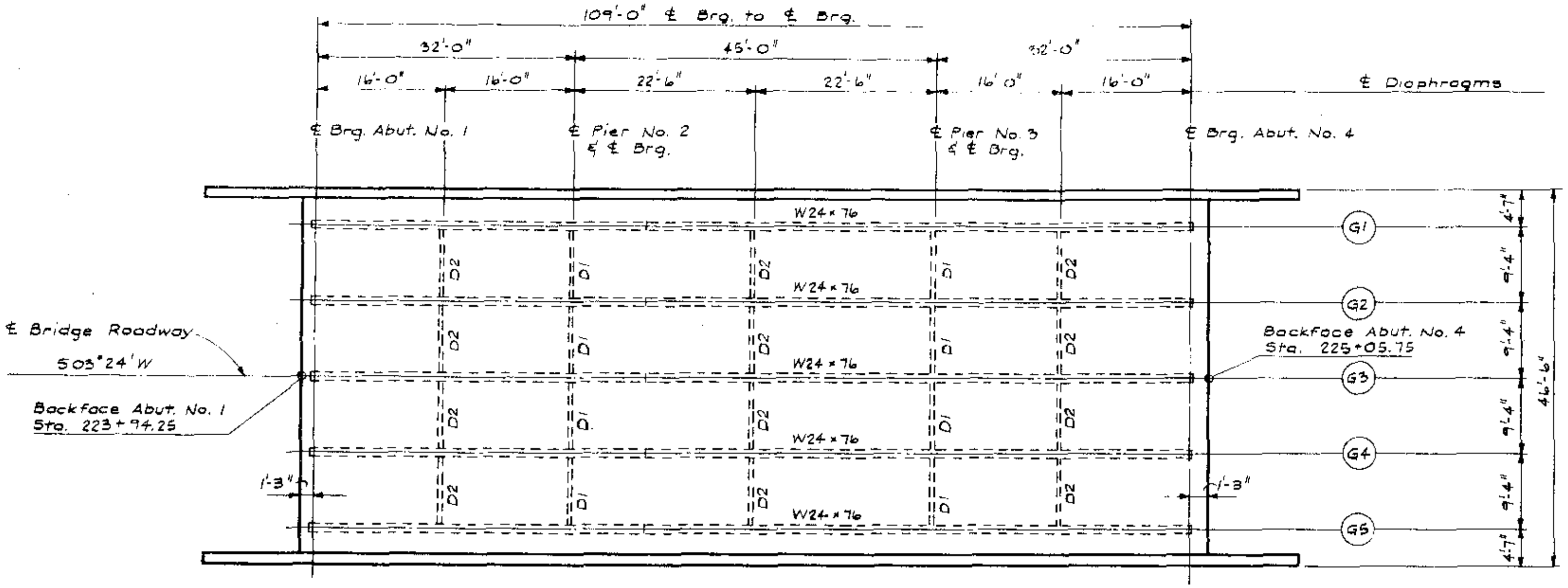
Designer		Structure Numbers	C-9-AR
Detailer			
Drawing Number B 6	of 15	Drawings	

Revision Dates (Preliminary Stage Only)

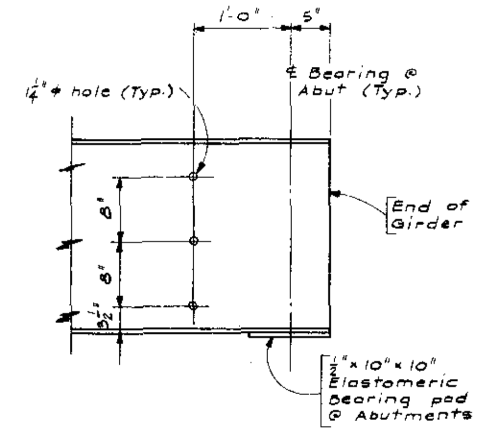
FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	RS 0131(7)	15	

REVISIONS

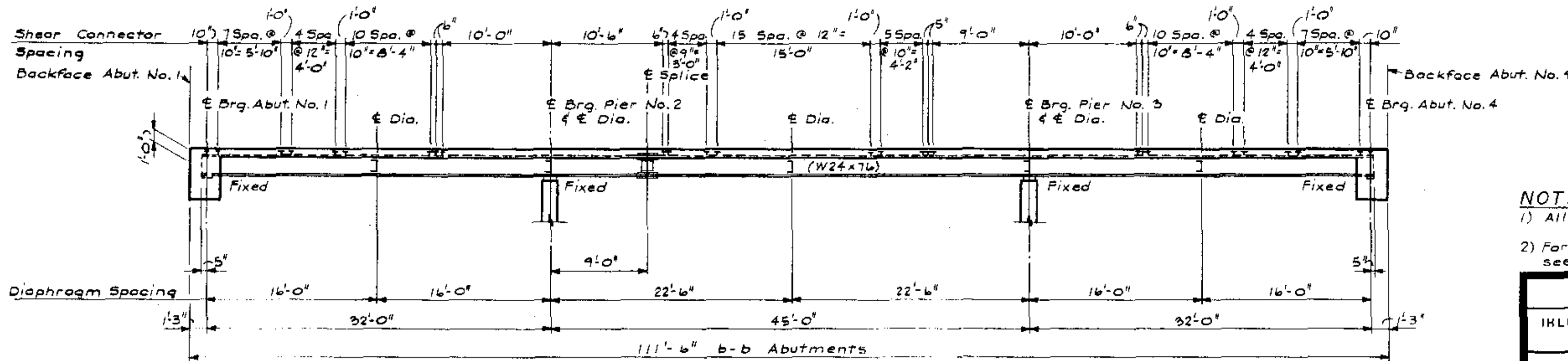
AS CONSTRUCTED
NO REVISIONS 6-1-77 REVISED VOID



PLAN



TYPICAL DETAIL
AT END OF GIRDER



LONGITUDINAL SECTION

Note:
Dead load deflection includes weight of slab & wearing surface

DEAD LOAD DEFLECTION	Tenth Point	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5
	Deflection in In.	0	.057	.104	.135	.141	.129	.098	.058	.017	-.009	0	.094	.233	.367	.461	.495

NOTES:
1) All W24×76 are A572 (Gr. 50) steel.
2) For Shear Connector details, see Dwg. No. B-12.

DIVISION OF HIGHWAYS

IHLENFELDT, PETERSON & HANEY, INC.
STRUCTURAL ENGINEERS

SUPERSTRUCTURE DETAILS

Designer	[illegible]	Structure Numbers	C-9-AP
Detailer	[illegible]		

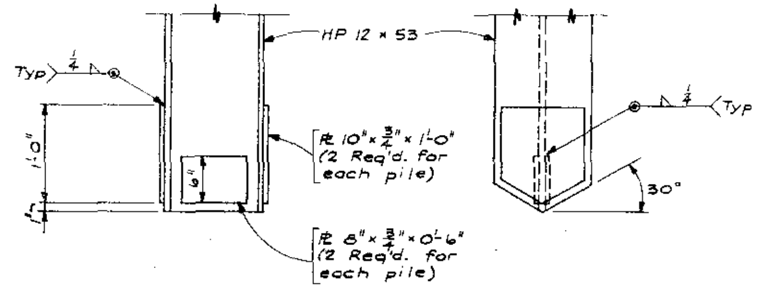
Drawing Number B 10 of 15 Drawings

Revision Dates (Preliminary Stage Only)

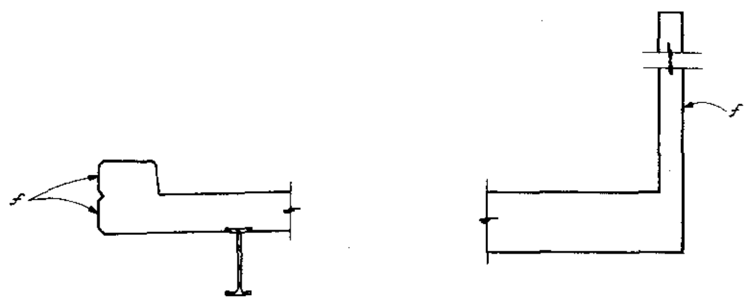
FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	RS 0131(7)	16	

REVISIONS

AS CONSTRUCTED
NO REVISIONS 6-1-77 REVISED VOID

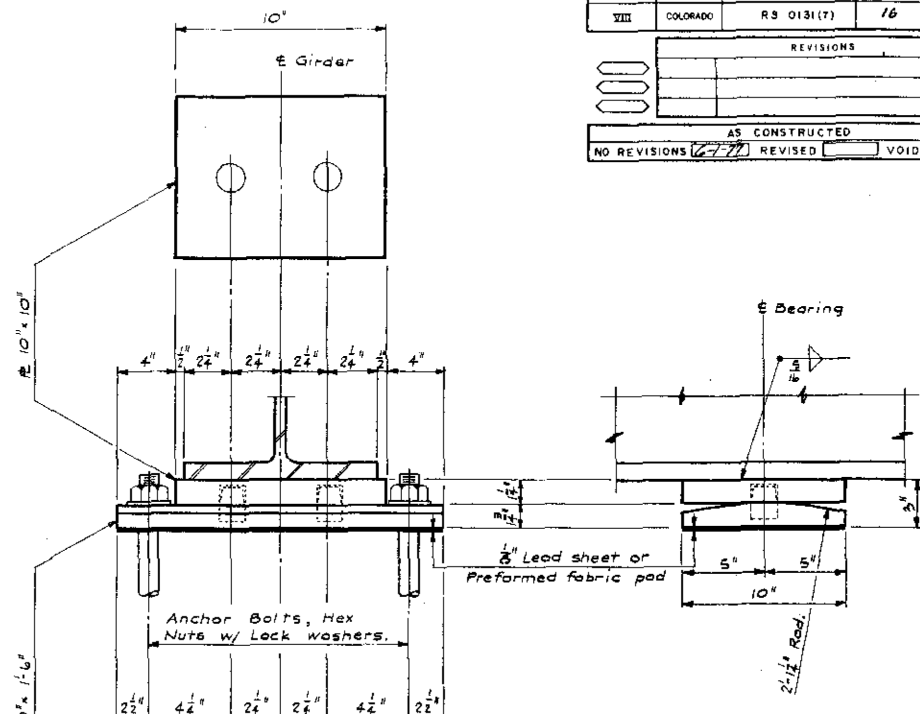


REINFORCING TIP DETAILS



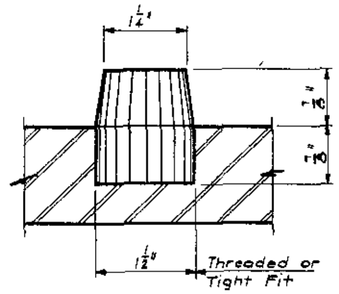
SURFACE FINISH DETAILS

Shows portions of structure to receive Class 2 Surface Finish.



FIXED BEARING DETAILS

5 Required @ Pier No. 2
5 Required @ Pier No. 3



PINTLE DETAIL

DIVISION OF HIGHWAYS

IHLENFELDT, PETERSON & HANEY, INC.
STRUCTURAL ENGINEERS

MISCELLANEOUS DETAILS

Designer B. Riddell ✓LDP	Structure Numbers	C-9-AR
Detailer B. Walton		

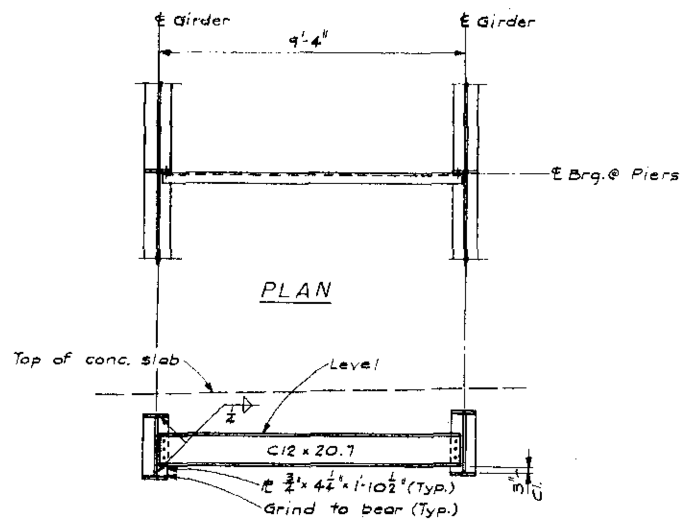
Drawing Number B 11 of 15 Drawings

Revision Dates (Preliminary Stage Only)

FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	RS 0131(7)	17	

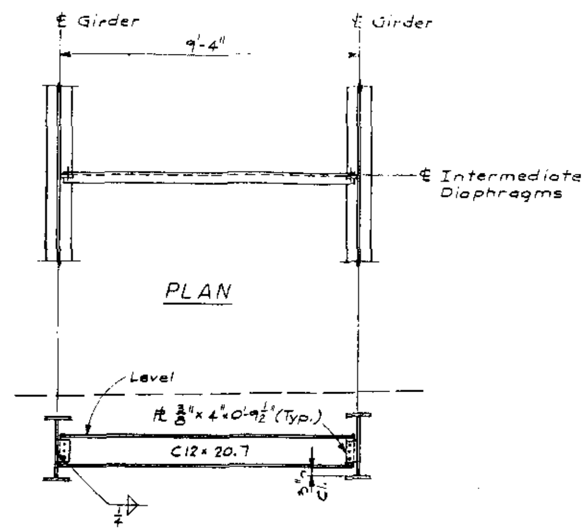
REVISIONS

AS CONSTRUCTED
NO REVISIONS 6-7-77 REVISED VOID



ELEVATION

DIAPHRAGM D1



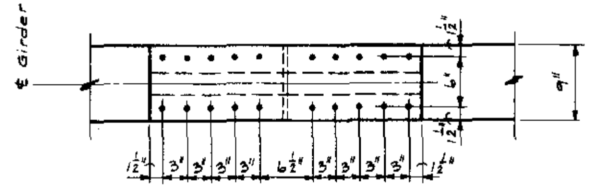
ELEVATION

DIAPHRAGM D2

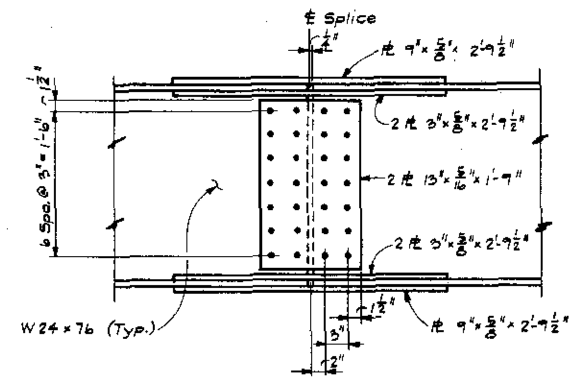
DIAPHRAGM DETAILS

NOTES:

1. All diaphragm bolts are 3/4" ϕ H.S.
2. Holes in diaphragm ℞'s shall be slotted (1 1/2" × 13/16" slots).
3. The intermediate diaphragm bolted connections shall not be torqued until the slab has been poured.



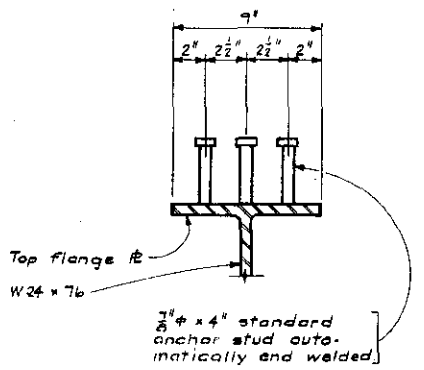
TOP AND BOTTOM PLATES



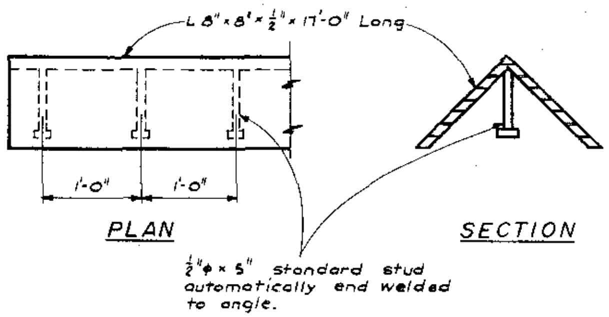
ELEVATION

SPLICE DETAILS

Note: All splice bolts are H.S. 7/8" ϕ.



SHEAR CONNECTOR DETAILS



PIER NOSE ANGLE DETAILS
(2 required)

DIVISION OF HIGHWAYS

IHLENFELDT, PETERSON & HANEY, INC.
STRUCTURAL ENGINEERS

MISCELLANEOUS DETAILS

Designer	R. Riddell / LDP	Structure Numbers	C-9-AR
Detailer	D. Walton		
Drawing Number B 12		of 15	Drawings

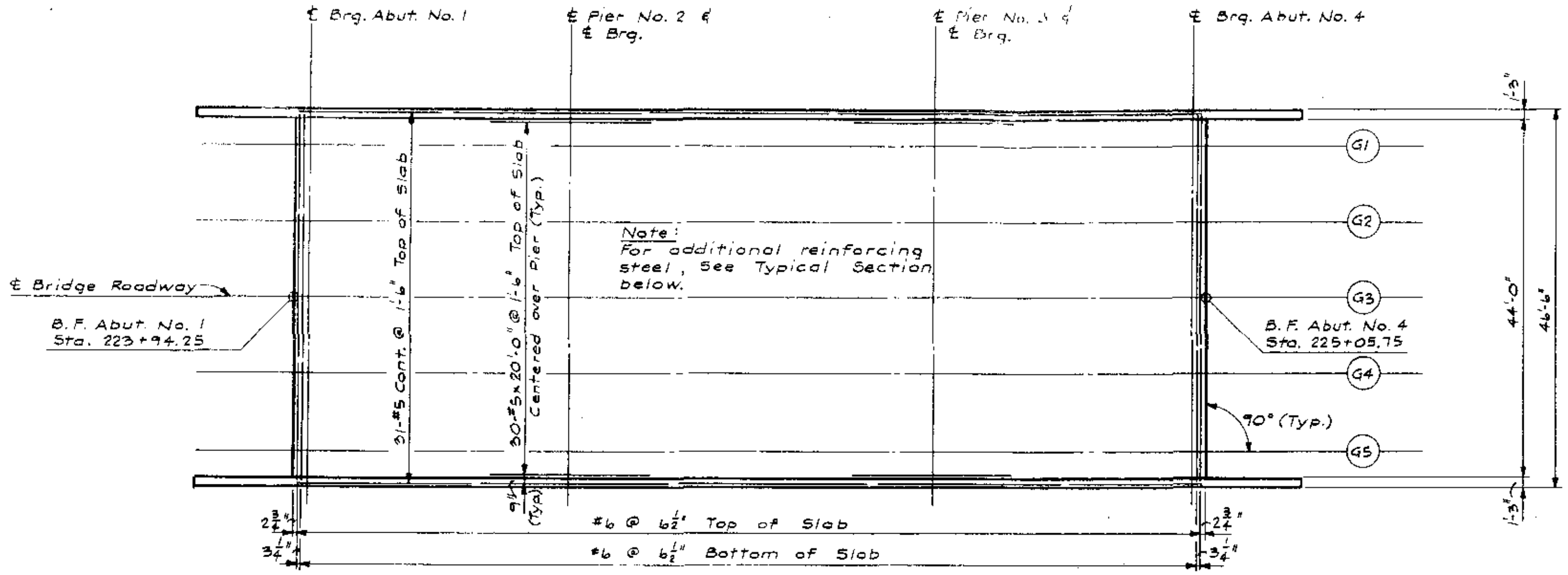
Revision Dates (Preliminary Stage Only)

FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	R S 0131(7)	18	

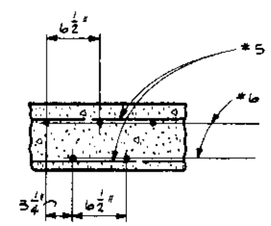
REVISIONS

AS CONSTRUCTED

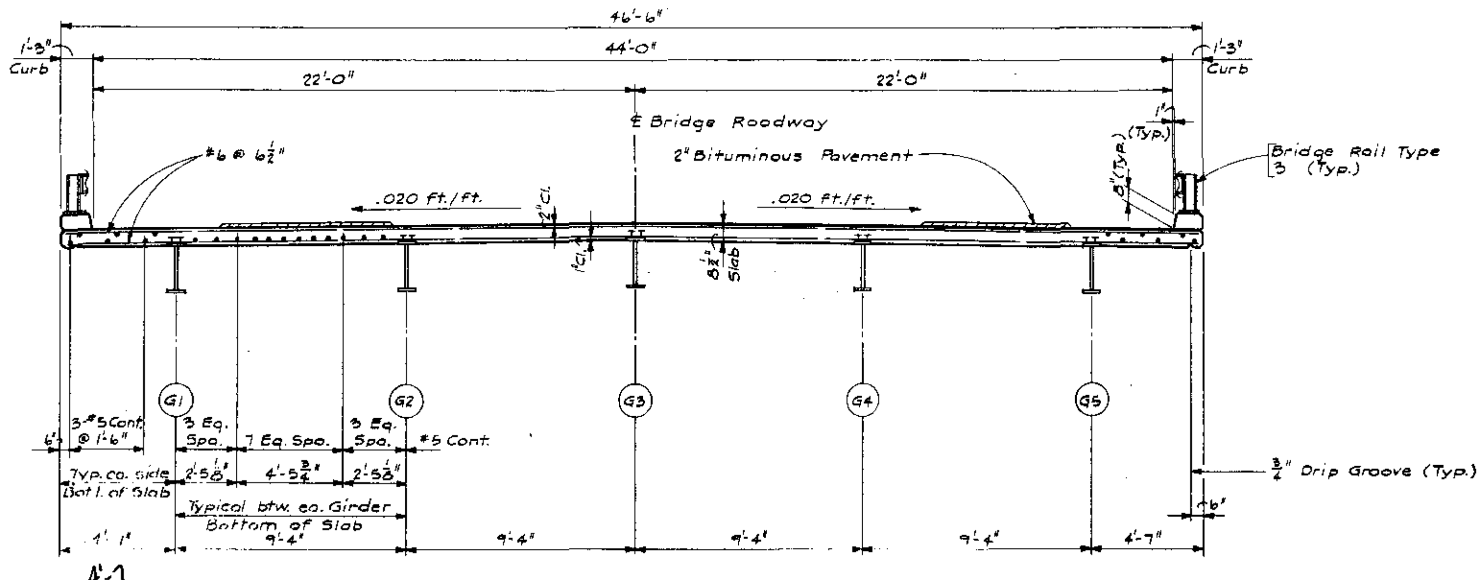
NO REVISIONS 6-1-77 REVISED VOID



SLAB PLAN



TYPICAL LONGITUDINAL SECTION THRU SLAB



TYPICAL SECTION

NOTES:

1. For Curb Reinforcing, See Dwg. No. B-14.

DIVISION OF HIGHWAYS

IHLENFELDT, PETERSON & HANEY, INC.
STRUCTURAL ENGINEERS

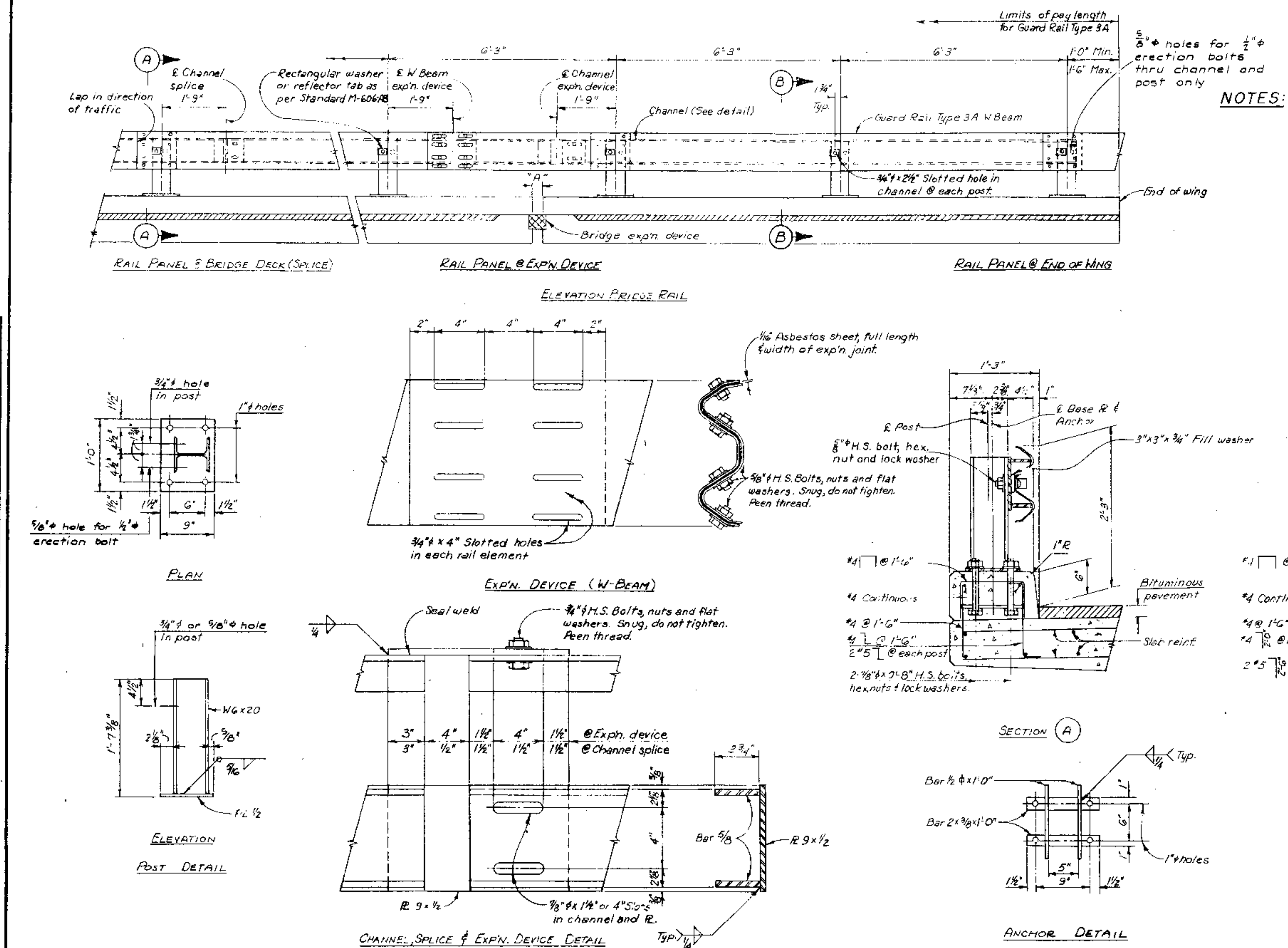
SLAB DETAILS

Designer: B. Kirkland VLDP — Structure Numbers: C-9-AR
Detailer: B. Walton
Drawing Number B 13 of 15 Drawings

FEDERAL ROAD REGION NO.	DIVISION	PROJ. NO.	SHEET NO	TOTAL SHEETS
VIII	COLORADO	RS 0131(7)	19	

REVISIONS

AS CONSTRUCTED
NO REVISIONS 6-1-77 REVISED VOID



NOTES:

POSTS SHALL BE PERPENDICULAR TO THE GRADE OF THE DECK.

ALL POSTS, CHANNEL, CHANNEL SPLICE, EXPANSION DEVICE, ANCHOR ASSEMBLY, BOLTS, NUTS AND WASHERS SHALL BE GALVANIZED AFTER FABRICATION IN ACCORDANCE WITH THE SPECIFICATIONS AND SHALL BE MEASURED AND PAID FOR IN ACCORDANCE WITH SECTION 509.

CHANNEL SHALL BE CONTINUOUS OVER NOT LESS THAN TWO (2) POSTS.

POSTS AT EXPANSION JOINT SHALL BE 1'-9" MINIMUM FROM THE CENTER LINE OF THE JOINT TO THE CENTER LINE OF POST MEASURED ALONG THE CENTER LINE OF POSTS.

ONE OR MORE 6'-3" PANELS MAY BE REDUCED (5'-0" MIN.) IN ORDER TO MAINTAIN DIMENSIONS FROM THE END OF WINGS AND EXPANSION JOINTS.

ALL EXPOSED CORNERS SHALL BE GROUND SMOOTH.

SEE STANDARD M-606-AB FOR ADDITIONAL DETAILS.

THE BACKING CHANNEL SHALL BE SHOP BENT OR FABRICATED TO FIT HORIZONTAL CURVE WHEN THE RADIUS IS LESS THAN 1500 FEET.

"GUARD RAIL TYPE 3A W BEAM" SHALL BE SHOP BENT OR FABRICATED TO FIT HORIZONTAL CURVE WHEN THE RADIUS IS LESS THAN 150 FEET.

DIVISION OF HIGHWAYS

IHLENFELDT, PETERSON & HANEY, INC.
STRUCTURAL ENGINEERS

BRIDGE RAIL TYPE 3

Designer J. Giavina | Structure Numbers C-9-AR
Detailer J. R. Ewert
Drawing Number B 14 of 15 Drawings

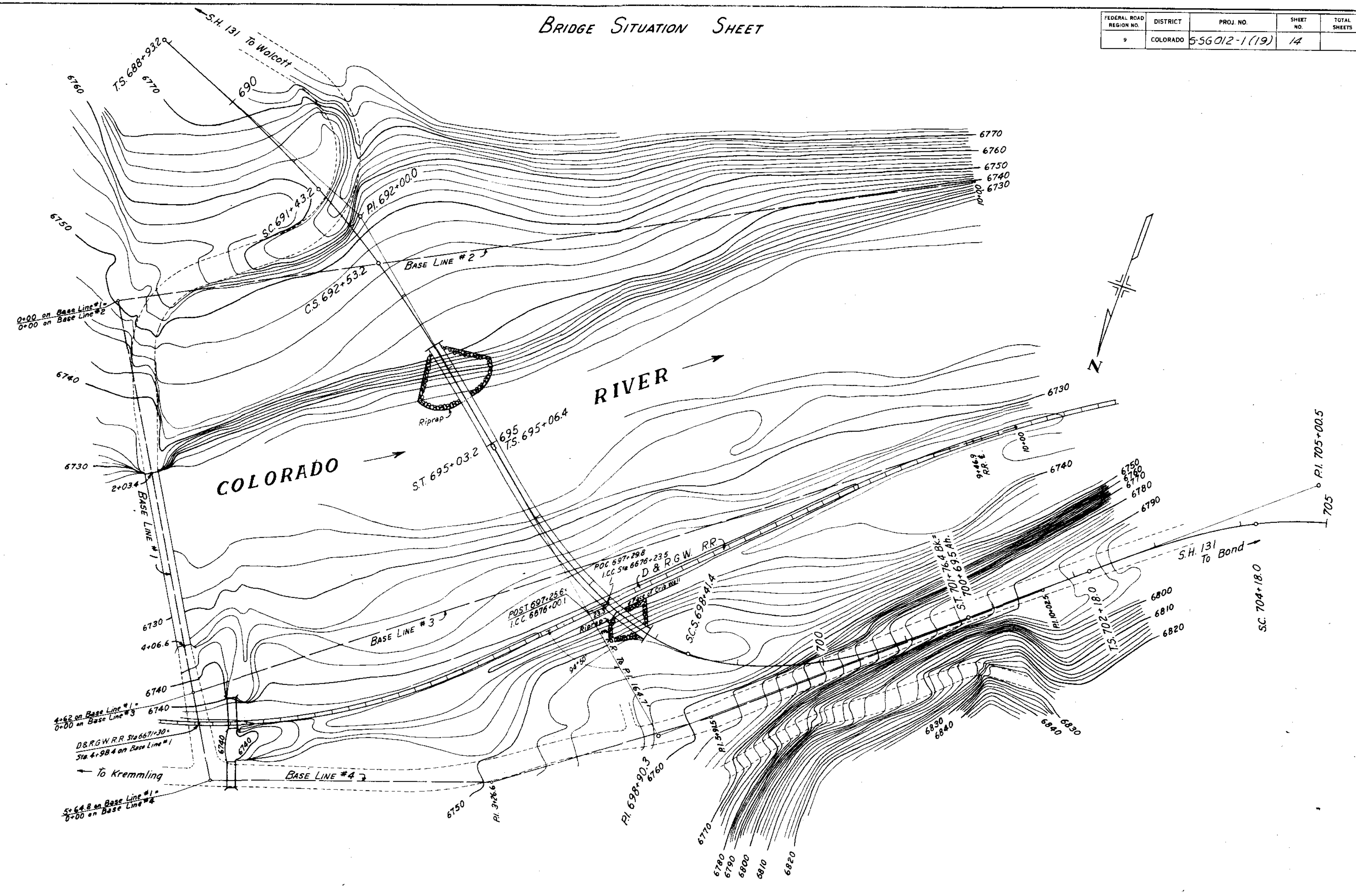
(12-17-75)

Revision Dates (Preliminary Stage Only)

DEPARTMENT OF HIGHWAYS — STATE OF COLORADO
FORM D.O.H. 126
MARCH 1964

Bridge Situation Sheet

Federal Road Region No.	District	Proj. No.	Sheet No.	Total Sheets
9	Colorado	S-SG012-1(19)	14	

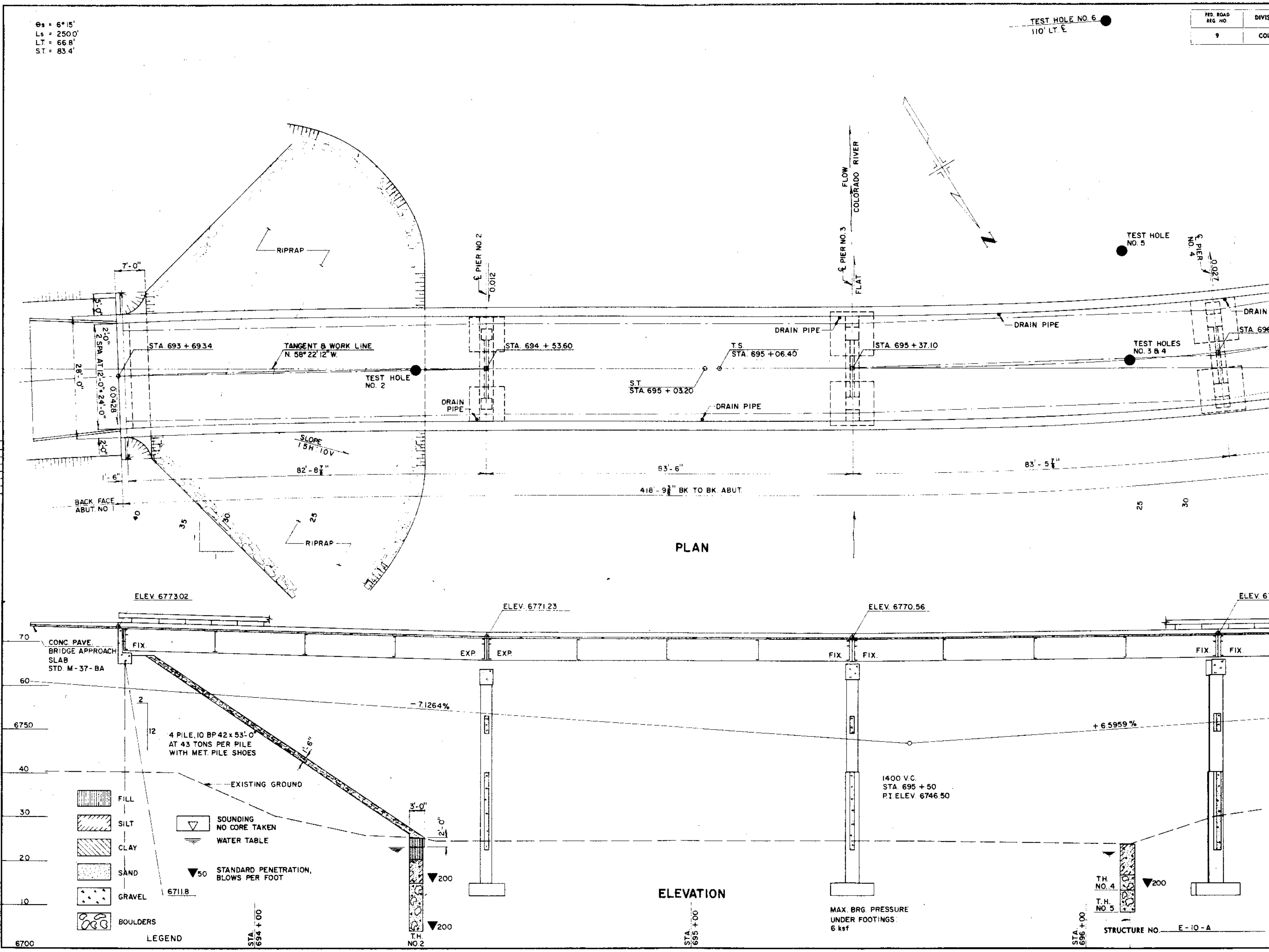


REVISIONS

REVISIONS

FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	S-SG0121 (19)	16	

BOND — STATE BRIDGE



STRUCTURE NO. E-10-A

JEFFERSON ASSOCIATES
ENGINEERS And SURVEYORS
1800 JACKSON ST. GOLDEN, COLORADO

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO

GENERAL PLAN & ELEVATION

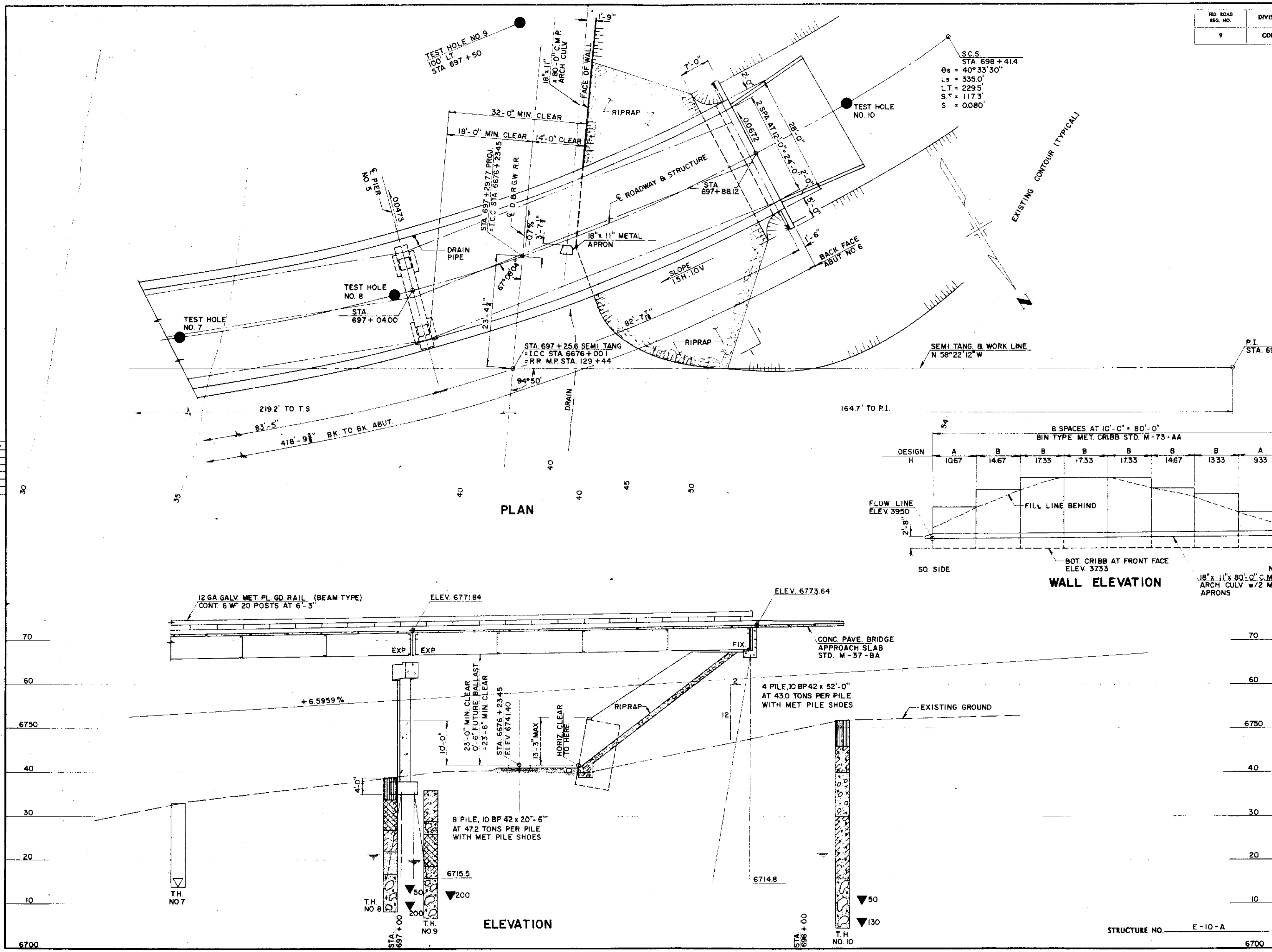
Across COLO. RIVER & D. & R.G.W. R.R.
Sta. 693 + 69.34 Sta. 697 + 88.12
Near State Bridge Sec. 26 T. 2S. R. 83W.

Designed by T.V.S.	Approved by
Made by F.F.J.	Bridge Engineer
Checked by M.L.K.	Date: 19

REVISIONS

FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	S-SG 0121 (19)	17	

BOND - STATE BRIDGE



JEFFERSON ASSOCIATES
ENGINEERS And SURVEYORS
1800 JACKSON ST. GOLDEN, COLORADO

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO

GENERAL PLAN & ELEVATION

Across COLO. RIVER & D.& R.G.W. R.R.
Sta. 693 + 69.34 – Sta. 697 + 88.12
Near State Bridge Sec. 26 T. 2S R. 83W

Designed by T.V.S.	Approved by
Made by F.F.J.	Bridge Engineer
Checked by M.L.K.	Date: 19

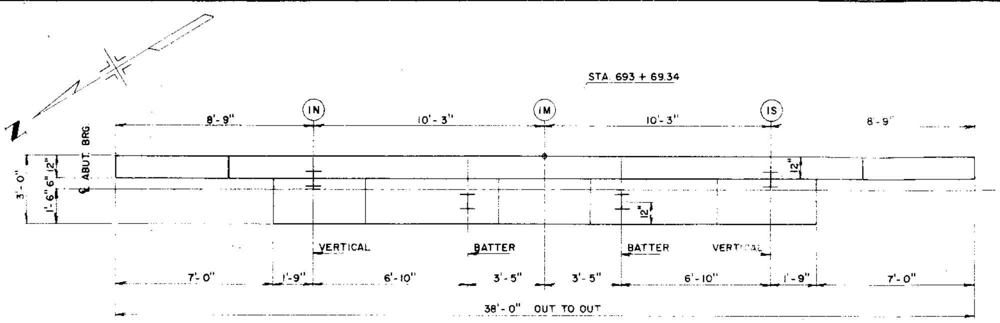
STRUCTURE NO. E-10-A

REVISIONS

REVISIONS

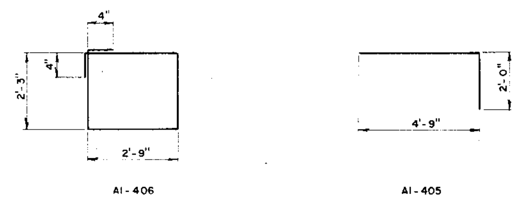
FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	S-SG0121 (19)	18	

BOND - STATE BRIDGE



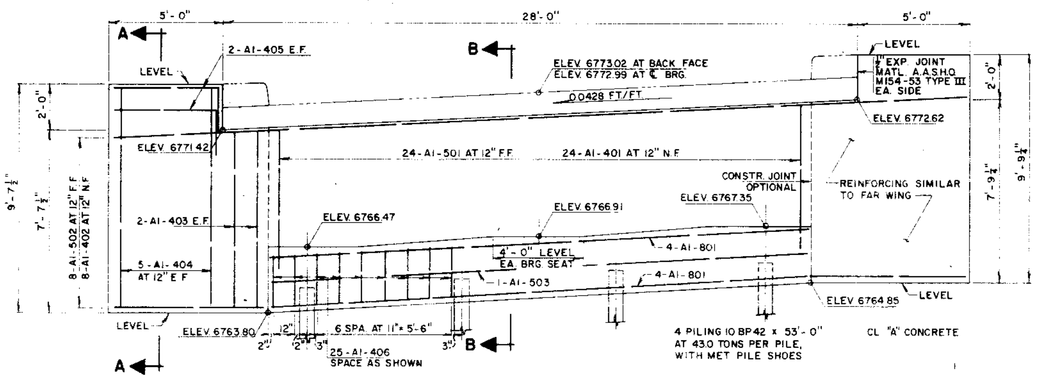
PLAN

REQUIRED THIS ABUT.
3 MASONRY BEARING ℄ M2



BAR BENDING DETAILS

BAR LIST				
MARK	SIZE	SHAPE	NO. REQD.	LENGTH
A1-401	4		24	6'-3"
402	4		8	37'-9"
403	4		8	7'-6"
404	4		20	9'-6"
405	4		8	6'-9"
406	4		25	10'-8"
A1-501	5		24	6'-3"
502	5		8	37'-9"
503	5		1	23'-9"
A1-801	8		8	23'-9"

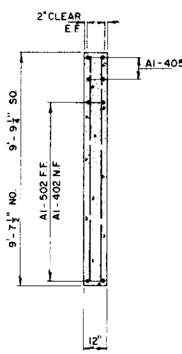


ELEVATION

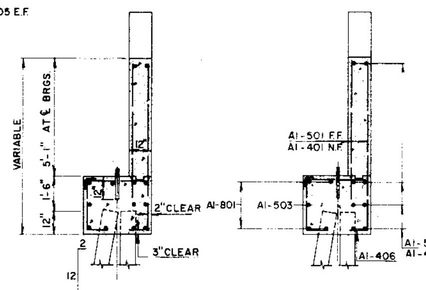
BAR SUMMARY						
1067	L.F. #4	AT	0.668	#/FT.	=	715
476	L.F. #5	AT	1.043	#/FT.	=	495
190	L.F. #8	AT	2.670	#/FT.	=	510
				TOTAL	=	1720 LB.

SUMMARY OF QUANTITIES				
	ITEM	UNIT	DESCRIPTION	AMOUNT
	14	CU. YD.	UNC. STR. EXCAV. (BRIDGES)	29
	16	CU. YD.	STR. BACKFILL	10
	46	CU. YD.	CL. "A" CONCRETE	140
	47	LB.	REINF. STEEL	1720
①	48	L.S.	STR. STEEL	—
	~~60~~	~~EA.~~	~~METAL PILE SHOES~~	~~4~~
	61	LIN. FT.	STEEL PILING 10 BP 42	212
②	—	SQ. FT.	1/2" EXP. JT. MATL.	28

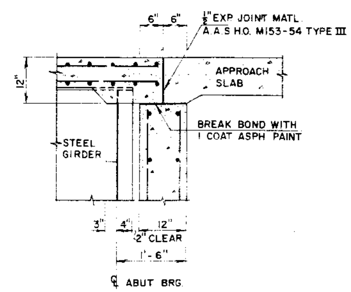
① DESIGN WEIGHT = 299 LB.
② NOT A PAY ITEM. PAYMENT SHALL BE INCLUDED IN UNIT BID PRICE FOR ITEM 46



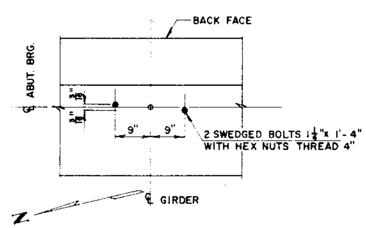
SECTION A-A



SECTION B-B



DETAIL AT TOP OF BACKWALL



ANCHOR BOLT TEMPLATE

STRUCTURE NO. E-10-A

JEFFERSON ASSOCIATES
ENGINEERS And SURVEYORS
1800 JACKSON ST. GOLDEN, COLORADO

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO

DETAILS
ABUTMENT NO. 1

Across COLO. RIVER & D. & R.G.W. R.R.
Sta. 693 + 69.34 - Sta. 697 + 88.12
Near State Bridge Sec. 26 T. 2S R. 83W

Designed by T.V.S.	Approved by
Made by F.F.J.	Bridge Engineer
Checked by L.H.C.	Date: 19

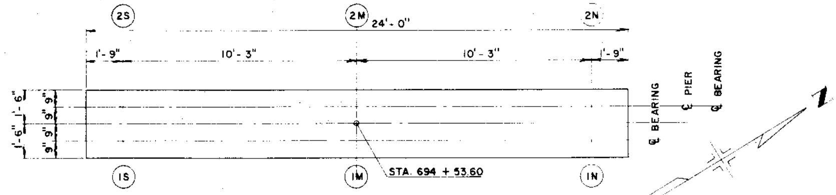
REVISIONS

REVISIONS

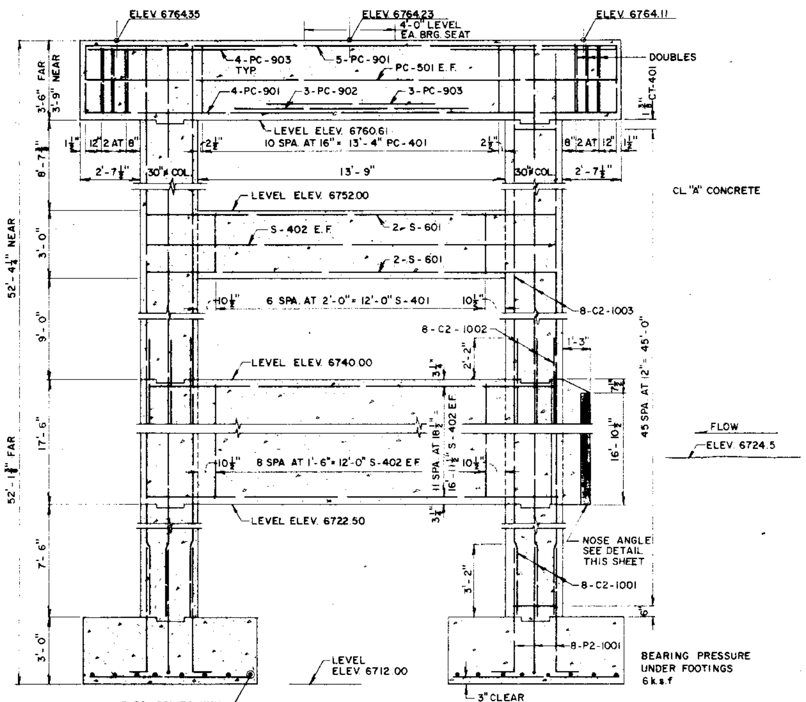
REQUIRED THIS PIER
6 MASONRY BRG. ℞ M1
6 ROCKERS R1

FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	S-SG0121 (19)	19	

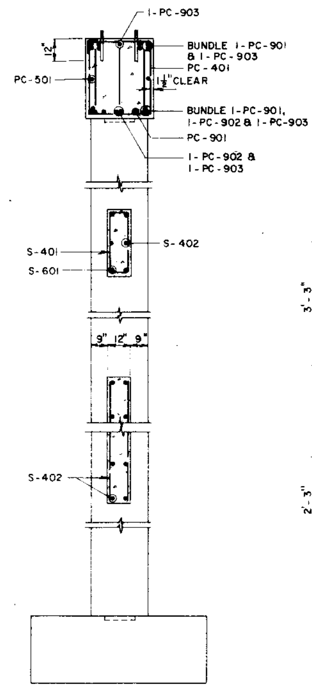
BOND – STATE BRIDGE



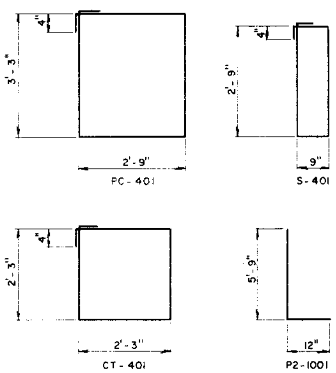
CAP BEAM PLAN



ELEVATION



SECTION



BAR BENDING DETAILS

MARK	SIZE	SHAPE	NO. REQD	LENGTH
CT-401	4		92	9'-8"
PC-401	4		25	12'-8"
S-401	4		7	7'-8"
S-402	4	—	44	17'-3"
PC-501	5	—	2	23'-9"
P2-601	6		32	7'-3"
S-601	6		4	18'-6"
PC-901	9	—	9	23'-9"
PC-902	9		3	10'-6"
PC-903	9		11	7'-6"
P2-1001	10		16	6'-9"
C2-1001	10		16	25'-0"
C2-1002	10	—	16	4'-4"
C2-1003	10		16	24'-0"

BAR LIST

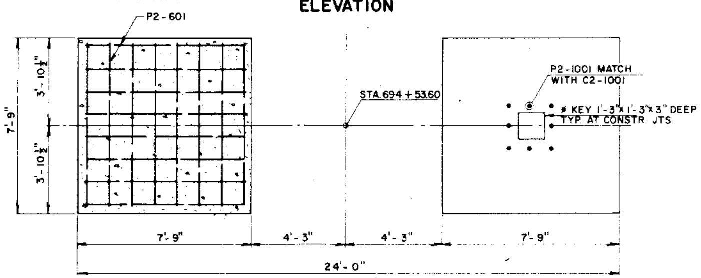
BAR SUMMARY

2020 L.F. #4	AT	0.668 #/FT.	=	1350
48 L.F. #5	AT	1.043 #/FT.	=	50
306 L.F. #6	AT	1.502 #/FT.	=	460
328 L.F. #9	AT	3.400 #/FT.	=	1115
961 L.F. #10	AT	4.303 #/FT.	=	4130
		TOTAL	=	7105 LB.

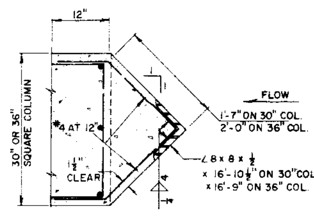
SUMMARY OF QUANTITIES

ITEM	UNIT	DESCRIPTION	AMOUNT
14	CU. YD.	UNCL. STR. EXCAV. (BRIDGES)	91
16	CU. YD.	STR. BACKFILL (CLASS X)	72
46	CU. YD.	CL. "A" CONCRETE	55
47	LB.	REINF. STEEL	7105
① 48	L.S.	STR. STEEL	—

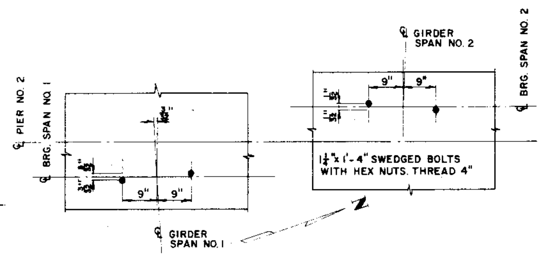
① DESIGN WEIGHT = 2400 LB.



FOOTING PLAN



NOSE ANGLE DETAIL
WEIGHT OF #4 BARS IN ASSY. INCLUDED FOR PAYMENT IN ITEM 48



ANCHOR BOLT TEMPLATE

STRUCTURE NO. E-10-A

JEFFERSON ASSOCIATES
ENGINEERS And SURVEYORS
1800 JACKSON ST. GOLDEN, COLORADO

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO

DETAILS
PIER NO. 2

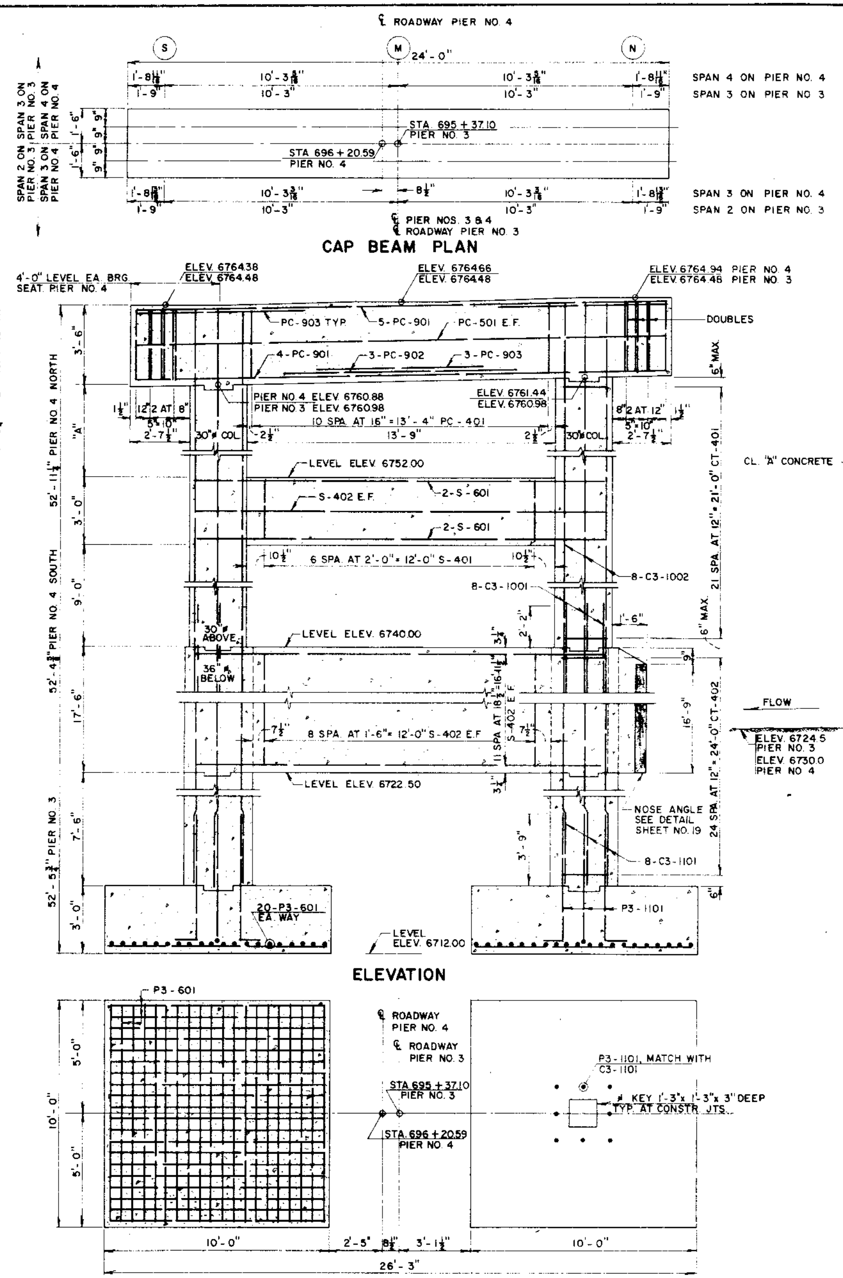
Across COLO. RIVER & D. & R.G.W. R.R.
Sta. 693 + 69.34 - Sta. 697 + 88.12
Near State Bridge Sec. 26 T. 2S. R. 83W.

Designed by T.V.S.	Approved by
Made by F.F.J.	Bridge Engineer
Checked by L.H.C.	Date: 19

REVISIONS

FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	S-SG0121 (19)	20	

BOND - STATE BRIDGE

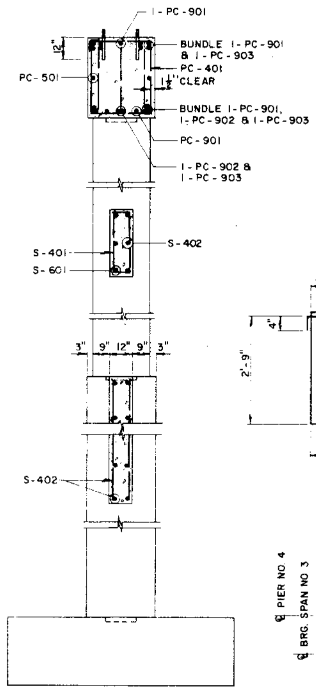


CAP BEAM PLAN

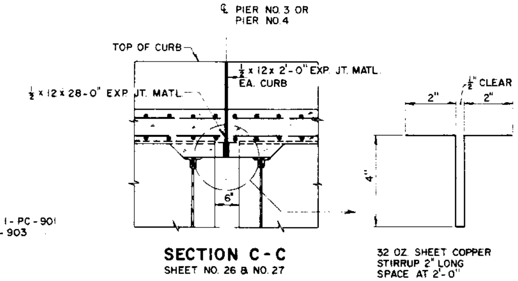
ELEVATION

FOOTING PLAN

REQUIRED PIER NO. 3 & PIER NO. 4
6 MASONRY BRG. ℄ M2 EA. PIER

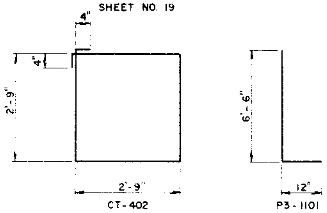


SECTION

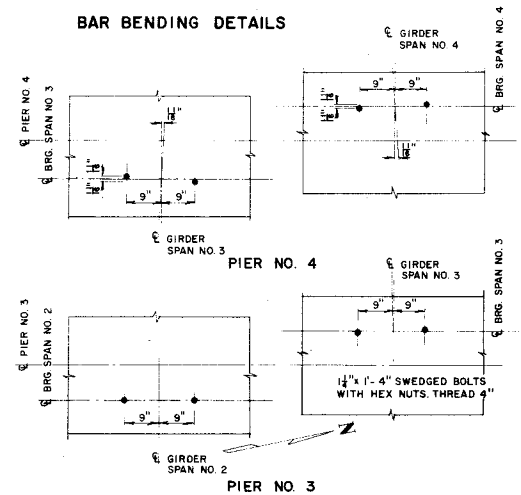


SECTION C-C
SHEET NO. 26 & NO. 27

NOTE
SEE BAR BENDING DETAILS
SHEET NO. 19



BAR BENDING DETAILS



PIER NO. 4

PIER NO. 3

ANCHOR BOLT TEMPLATE

PIER NO. 3 OR PIER NO. 4

BAR LIST

MARK	SIZE	SHAPE	NO. REQD.	LENGTH
CT - 401	4		44	9'- 8"
CT - 402	4		50	11'- 8"
S - 401	4		7	7'- 8"
PC - 401	4		25	12'- 8"
S - 402	4		44	17'- 6"
PC - 501	5		2	23'- 9"
P3 - 601	6		80	9'- 6"
S - 601	6		4	18'- 6"
PC - 901	9		9	23'- 9"
PC - 902	9		3	10'- 6"
PC - 903	9		11	7'- 6"
C3 - 1001	10		16	4'- 4"
C3 - 1002	10		16	24'-0"
C3 - 1101	11		16	24'- 9"
P3 - 1101	11		16	7'- 6"

PIER NO. 3 OR PIER NO. 4

BAR SUMMARY

2150	L.F. #4	AT 0.668 #/FT.	=	1435
48	L.F. #5	AT 1.043 #/FT.	=	50
834	L.F. #6	AT 1.502 #/FT.	=	1250
328	L.F. #9	AT 3.400 #/FT.	=	1115
453	L.F. #10	AT 4.303 #/FT.	=	1960
516	L.F. #11	AT 5.313 #/FT.	=	2740
		TOTAL	=	8550 LB.

PIER NO. 3 OR PIER NO. 4

SUMMARY OF QUANTITIES

ITEM	UNIT	DESCRIPTION	NO.3 AMT.	NO.4 AMT.
14	CU. YD.	UNCL. STR. EXCAV. (BRIDGES)	115	171
16	CU. YD.	STR. BACKFILL	84	132
46	CU. YD.	CL. "A" CONCRETE	69	69
47	LB.	REINF. STEEL	8550	8550
48 ①	L.S.	STR. STEEL	—	—
80	LB.	SHEET COPPER (32 OZ.)	5	5
– ②	SQ. FT.	½" EXP. JT. MATL.	32	32

① DESIGN WEIGHT = 1546 LB. EA. PIER
② NOT A PAY ITEM. PAYMENT SHALL BE INCLUDED IN UNIT BID PRICE FOR ITEM 46.

JEFFERSON ASSOCIATES
ENGINEERS And SURVEYORS.
1800 JACKSON ST. GOLDEN, COLORADO

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO

DETAILS
PIER NO. 3
PIER NO. 4

Across COLO. RIVER & D.& R.G.W. R.R.
Sta. 693 + 69.34 – Sta. 697 + 88.12
Near State Bridge Sec. 26 T. 2S. R.83W.

Designed by T.V.S.	Approved by
Made by F.F.J.	Bridge Engineer
Checked by G.D.C.	Date: 19

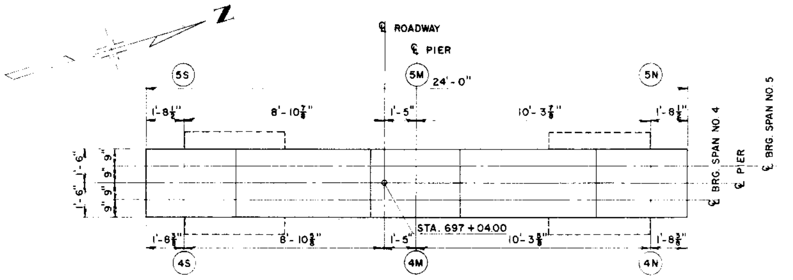
STRUCTURE NO. E-10-A

REVISIONS

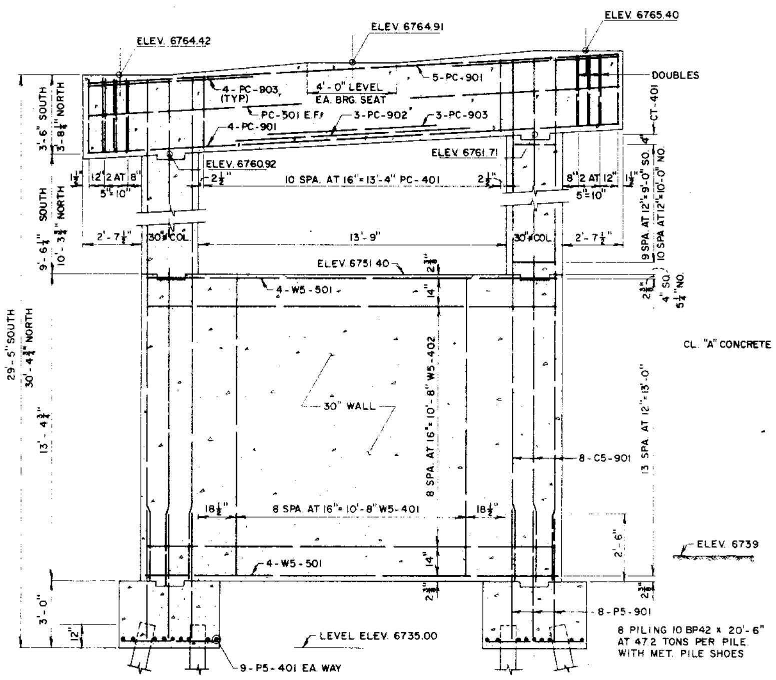
FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	S-SG 0121 (19)	21	

BOND – STATE BRIDGE

REQUIRED THIS PIER
6 MASONRY BRG. ℄ M1
6 ROCKERS R1

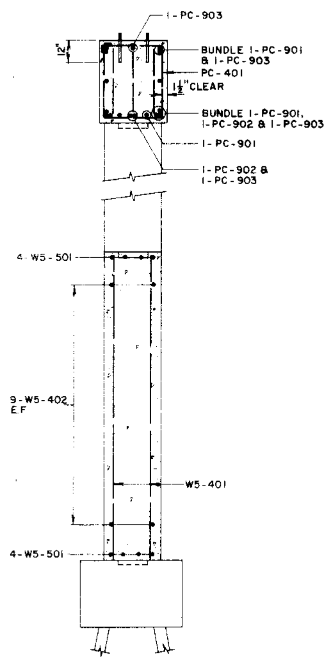


CAP BEAM PLAN



ELEVATION

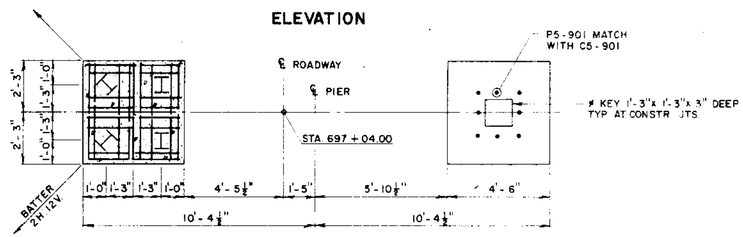
CL. "A" CONCRETE



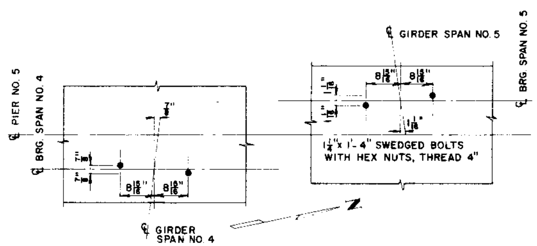
SECTION

NOTE

SEE BAR BENDING DETAILS SHEET NO. 19



FOOTING PLAN



ANCHOR BOLT TEMPLATE

BAR LIST

MARK	SIZE	SHAPE	NO. REQD.	LENGTH
P5-401	4		36	4'-0"
CT-401	4		49	9'-8"
PC-401	4		25	12'-8"
W5-401	4		18	13'-2"
W5-402	4		18	18'-6"
PC-501	5		2	23'-9"
W5-501	5		8	18'-6"
P5-901	9		16	5'-3"
C5-901	9		16	26'-3"
PC-901	9		9	23'-9"
PC-902	9		3	10'-6"
PC-903	9		11	7'-6"

BAR SUMMARY

1504 L.F. #4 AT 0.668 #/FT. = 1005
196 L.F. #5 AT 1.043 #/FT. = 205
832 L.F. #9 AT 3.400 #/FT. = 2825
TOTAL = 4035 LB.

SUMMARY OF QUANTITIES

ITEM	UNIT	DESCRIPTION	AMOUNT
14	CU. YD.	UNCL. STR. EXCAV. (BRIDGES)	19
16	CU. YD.	STR. BACKFILL (CLASS X)	10
46	CU. YD.	CL. "A" CONCRETE	43
47	LB.	REINF. STEEL	4035
① 48	L.S.	STR. STEEL	—
~~60~~	~~EA.~~	~~METAL PILE SHOES~~	~~8~~
61	LIN. FT.	STEEL PILING 10BP42	164

① DESIGN WEIGHT = 2639 LB.

JEFFERSON ASSOCIATES
ENGINEERS AND SURVEYORS
1800 JACKSON ST. GOLDEN, COLORADO

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO

DETAILS
PIER NO. 5

Across COLO. RIVER & D. & R.G.W. R.R.
Sta. 693 + 69.34 - Sta. 697 + 88.12
Near State Bridge Sec. 26 T. 2S R83W

Designed by T.V.S. Approved by
Made by F.F.J. Bridge Engineer
Checked by L.H.C. Date: 19

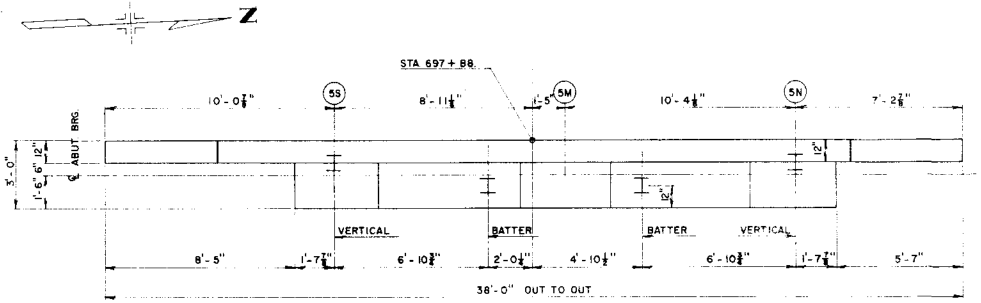
STRUCTURE NO. E-10-A

REVISIONS

REVISIONS

FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	S-SG 0121 (19)	22	

BOND – STATE BRIDGE

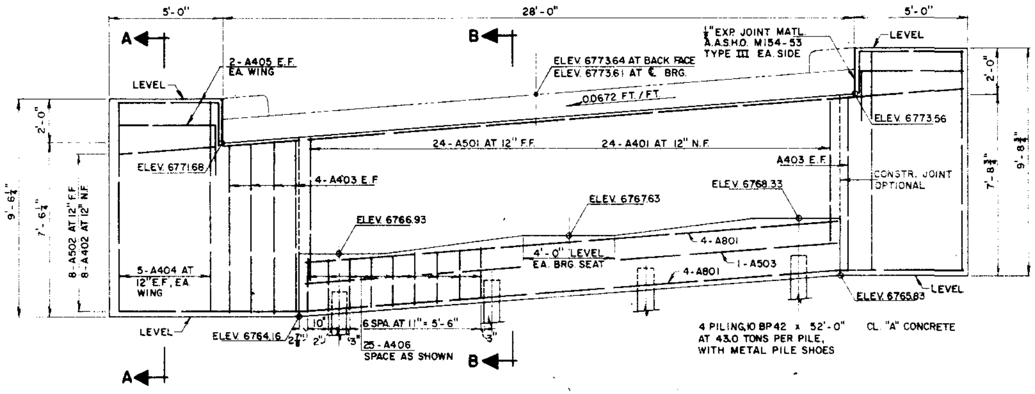


PLAN

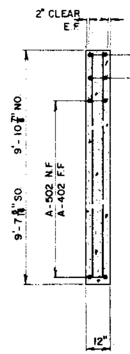
REQUIRED THIS ABUT.
3 MASONRY BRG. ℄ M2

NOTE

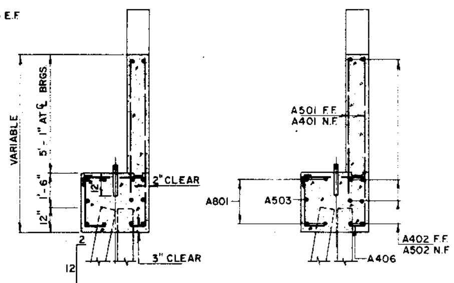
1. USE BAR BENDING DETAILS ABUT. NO. 1 SHEET NO. 18
2. SEE DETAIL AT TOP OF BACKWALL ABUT. NO. 1 SHEET NO. 18



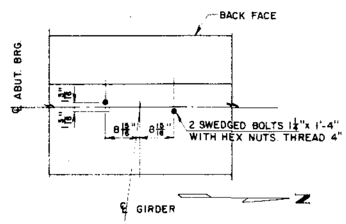
ELEVATION



SECTION A-A



SECTION B-B



ANCHOR BOLT TEMPLATE

BAR LIST

MARK	SIZE	SHAPE	NO. REQD.	LENGTH
A6-401	4		24	6'- 3"
A6-402	4		8	37'- 9"
A6-403	4		10	7'- 6"
A6-404	4		20	9'- 6"
A6-405	4		8	6'- 9"
A6-406	4		25	10'- 8"
A6-501	5		24	6'- 3"
A6-502	5		8	37'- 9"
A6-503	5		1	23'- 9"
A6-801	8		8	23'- 9"

BAR SUMMARY

1082 L.F. #4 AT 0.668 #/FT. = 725
476 L.F. #5 AT 1.043 #/FT. = 495
190 L.F. #8 AT 2.670 #/FT. = 510
TOTAL = 1730 LB.

SUMMARY OF QUANTITIES

	ITEM	UNIT	DESCRIPTION	AMOUNT
	14	CU. YD.	UNCL. STR. EXCAV. (BRIDGES)	29
	16	CU. YD.	STR. BACKFILL (CLASS X)	10
	46	CU. YD.	CL. "A" CONCRETE	140
	47	LB.	REINF. STEEL	1730
①	48	L.S.	STR. STEEL	—
	~~60~~	~~EA.~~	~~METAL PILE SHOES~~	~~4~~
	61	LIN. FT.	STEEL PILING	208
②	—	SQ. FT.	1/2" EXP. JT. MATL.	28

① DESIGN WEIGHT = 299 LB.
② NOT A PAY ITEM. PAYMENT SHALL BE INCLUDED IN UNIT BID PRICE FOR ITEM 46

STRUCTURE NO. E-10-A

JEFFERSON ASSOCIATES
ENGINEERS And SURVEYORS
1800 JACKSON ST. GOLDEN, COLORADO

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO

DETAILS
ABUTMENT NO. 6

Across COLO. RIVER & D.&R.G.W. R.R.
Sta. 693 + 69.34 - Sta. 697 + 88.12
Near State Bridge Sec. 26 T. 2S R.83W

Designed by T.V.S.	Approved by
Made by F.F.J.	Bridge Engineer
Checked by L.H.C.	Date: 19

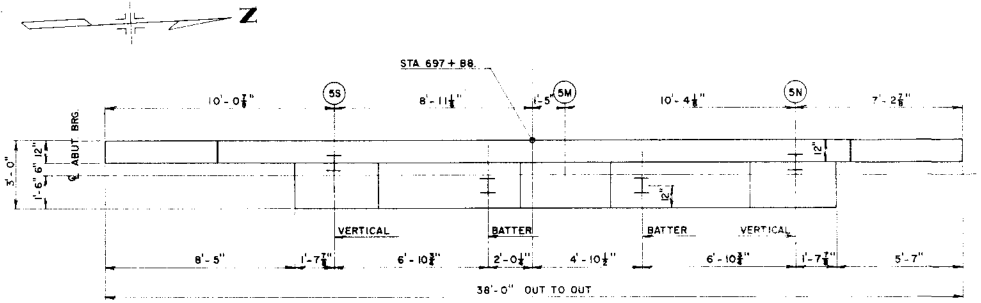
REVISIONS

REVISIONS

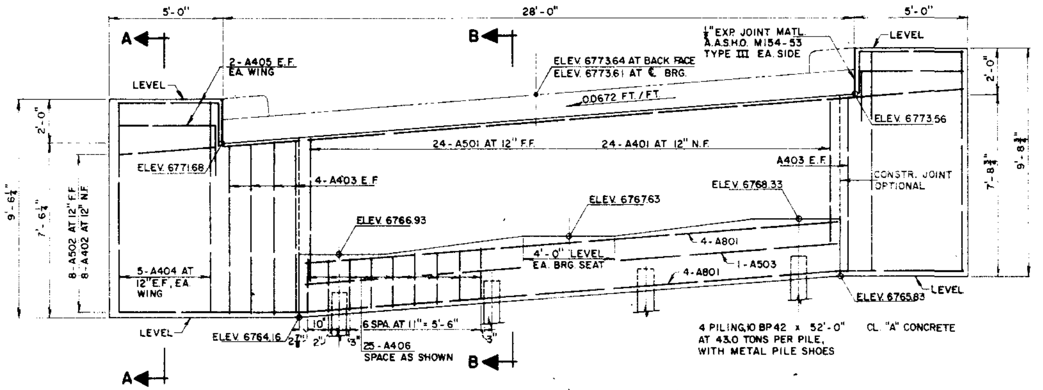
FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	S-SG 0121 (19)	22	

BOND – STATE BRIDGE

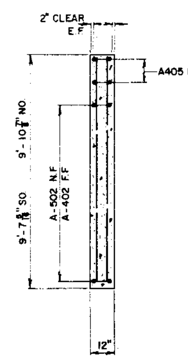
REQUIRED THIS ABUT.
3 MASONRY BRG. ℄ M2



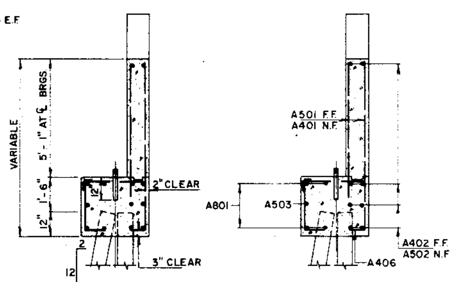
PLAN



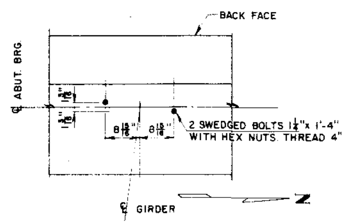
ELEVATION



SECTION A-A



SECTION B-B



ANCHOR BOLT TEMPLATE

NOTE

1. USE BAR BENDING DETAILS ABUT. NO. 1 SHEET NO. 18
2. SEE DETAIL AT TOP OF BACKWALL ABUT. NO. 1 SHEET NO. 18

BAR LIST

MARK	SIZE	SHAPE	NO. REQD.	LENGTH
A6-401	4		24	6'-3"
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A6-403	4		10	7'-6"
A6-404	4		20	9'-6"
A6-405	4		8	6'-9"
A6-406	4		25	10'-8"
A6-501	5		24	6'-3"
A6-502	5		8	37'-9"
A6-503	5		1	23'-9"
A6-801	8		8	23'-9"

BAR SUMMARY

1082	L.F. #4	AT	0.668	#/FT.	=	725
476	L.F. #5	AT	1.043	#/FT.	=	495
190	L.F. #8	AT	2.670	#/FT.	=	510
				TOTAL	=	1730 LB.

SUMMARY OF QUANTITIES

	ITEM	UNIT	DESCRIPTION	AMOUNT
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①	48	L.S.	STR. STEEL	—
	~~60~~	~~EA.~~	~~METAL PILE SHOES~~	~~4~~
	61	LIN. FT.	STEEL PILING	208
②	—	SQ. FT.	1/2" EXP. JT. MATL.	28

① DESIGN WEIGHT = 299 LB.
② NOT A PAY ITEM. PAYMENT SHALL BE INCLUDED IN UNIT BID PRICE FOR ITEM 46

JEFFERSON ASSOCIATES
ENGINEERS And SURVEYORS
1800 JACKSON ST. GOLDEN, COLORADO

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO

DETAILS
ABUTMENT NO. 6

Across COLO. RIVER & D.&R.G.W. R.R.
Sta. 693 + 69.34 - Sta. 697 + 88.12
Near State Bridge Sec. 26 T. 2S R.83W

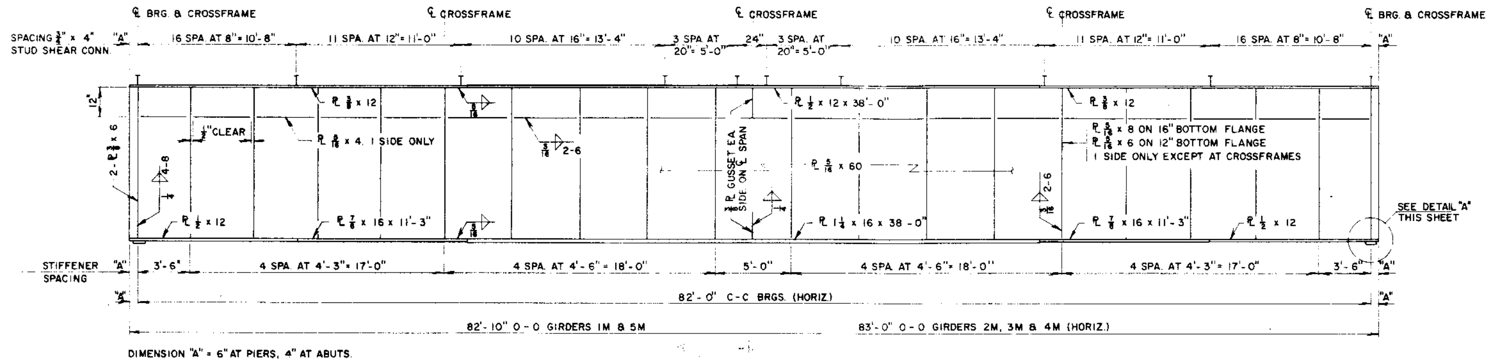
Designed by T.V.S.
Made by F.F.J.
Checked by L.H.C.
Approved by
Bridge Engineer
Date: 19

STRUCTURE NO. E-10-A

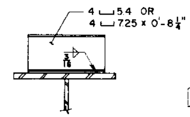
REVISIONS

FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	S-SG 0121 (19)	23	

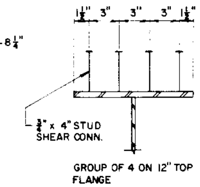
BOND – STATE BRIDGE



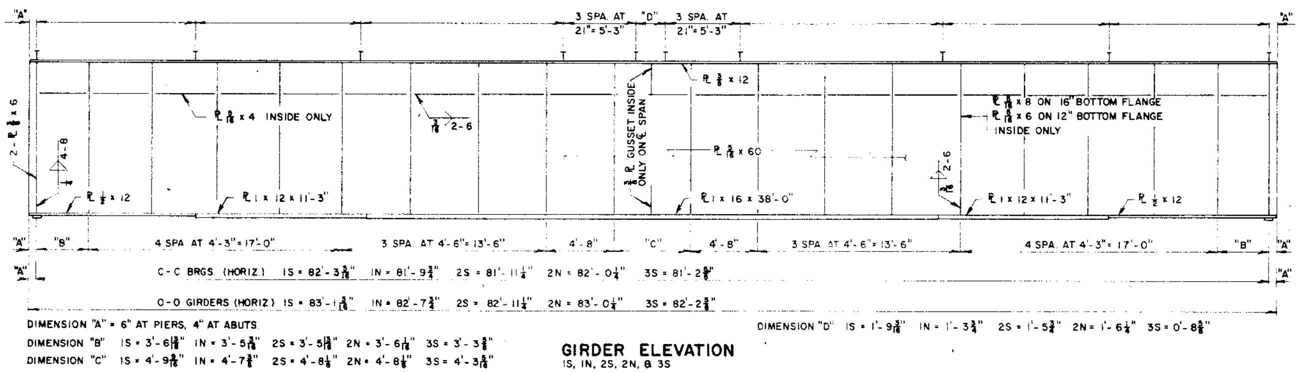
GIRDER ELEVATION
1M, 2M, 3M, 4M, & 5M



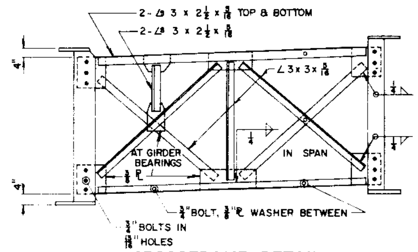
ALT. SHEAR CONNECTOR



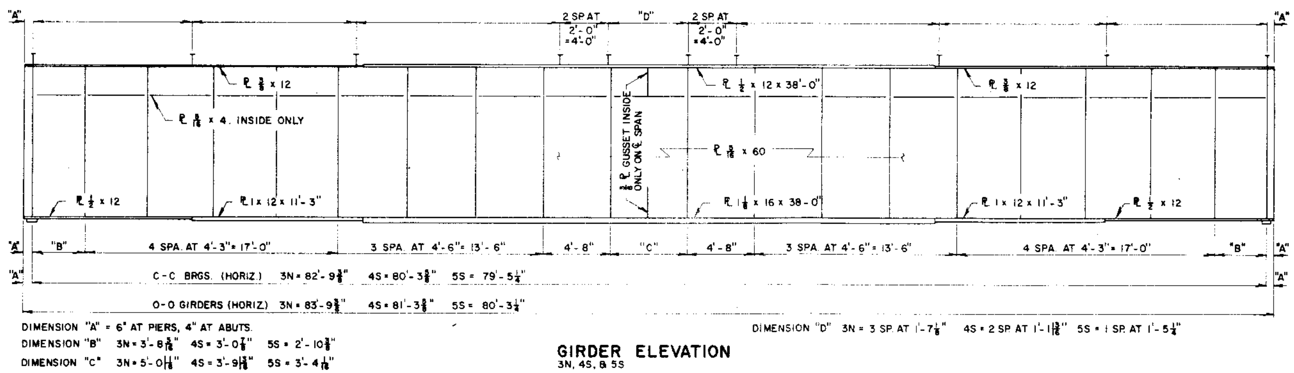
STUD SHEAR CONNECTOR LOCATION



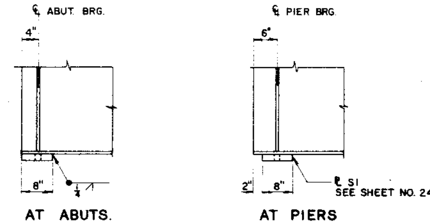
GIRDER ELEVATION
1S, 1N, 2S, 2N, & 3S



CROSSFRAME DETAIL
AT ALL LOCATIONS BETWEEN GIRDERS



GIRDER ELEVATION
3N, 4S, & 5S



DETAIL "A"

JEFFERSON ASSOCIATES
ENGINEERS And SURVEYORS
1800 JACKSON ST. GOLDEN, COLORADO

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO

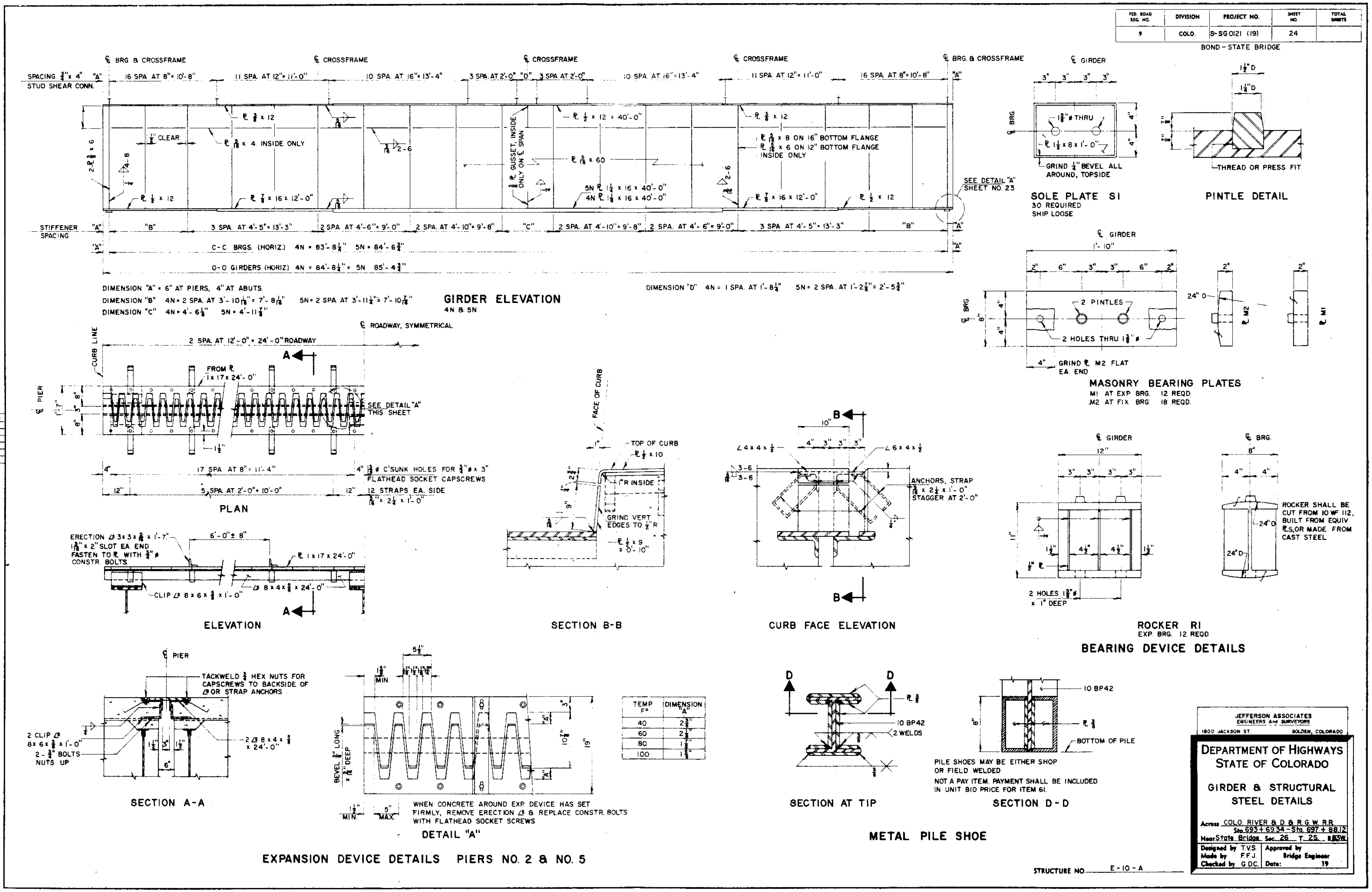
GIRDER & STRUCTURAL STEEL DETAILS

Across COLO. RIVER & D. & R.G.W. R.R.
Sta. 693 + 69.34 – Sta. 697 + 88.12
Near State Bridge Sec. 26 T. 2S. R. 83W.

Designed by T.V.S. | Approved by
Made by F.F.J. | Bridge Engineer
Checked by G.D.C. | Date: 19

STRUCTURE NO. E-10-A

REVISIONS



FED. ROAD REG. NO. 9 | DIVISION COLO. | PROJECT NO. S-SG 0121 (19) | SHEET NO. 24 | TOTAL SHEETS
BOND - STATE BRIDGE
GIRDER ELEVATION
4N & 5N
DIMENSION "A" = 6" AT PIERS, 4" AT ABUTS.
C-C BRGS. (HORIZ.) 4N = 83'-8¼" 5N = 84'-6¾"
O-O GIRDERS (HORIZ.) 4N = 84'-8¼" = 5N 85'-4¾"
SOLE PLATE S1
30 REQUIRED
SHIP LOOSE
PINTLE DETAIL
THREAD OR PRESS FIT
MASONRY BEARING PLATES
M1 AT EXP BRG. 12 REQD.
M2 AT FIX BRG. 18 REQD.
PLAN
ELEVATION
SECTION B-B
CURB FACE ELEVATION
ROCKER R1
EXP. BRG. 12 REQD.
BEARING DEVICE DETAILS
ROCKER SHALL BE CUT FROM 10 WF 112, BUILT FROM EQUIV PLS, OR MADE FROM CAST STEEL
SECTION A-A
DETAIL "A"
TEMP F° | DIMENSION "A"
40 | 2⅜"
60 | 2"
80 | 1⅝"
100 | 1¼"
WHEN CONCRETE AROUND EXP DEVICE HAS SET FIRMLY, REMOVE ERECTION LS & REPLACE CONSTR. BOLTS WITH FLATHEAD SOCKET SCREWS
EXPANSION DEVICE DETAILS PIERS NO. 2 & NO. 5
SECTION AT TIP
SECTION D-D
PILE SHOES MAY BE EITHER SHOP OR FIELD WELDED
NOT A PAY ITEM. PAYMENT SHALL BE INCLUDED IN UNIT BID PRICE FOR ITEM 61.
METAL PILE SHOE
JEFFERSON ASSOCIATES
ENGINEERS AND SURVEYORS
1800 JACKSON ST GOLDEN, COLORADO
DEPARTMENT OF HIGHWAYS
STATE OF COLORADO
GIRDER & STRUCTURAL STEEL DETAILS
Across COLO. RIVER & D & R.G.W. R.R.
Sta. 693+69.34 - Sta. 697+88.12
Near State Bridge Sec. 26 T. 2S. R. 83W.
Designed by T.V.S.
Made by F.F.J.
Checked by G.D.C.
Approved by Bridge Engineer
Date: 19
STRUCTURE NO. E-10-A

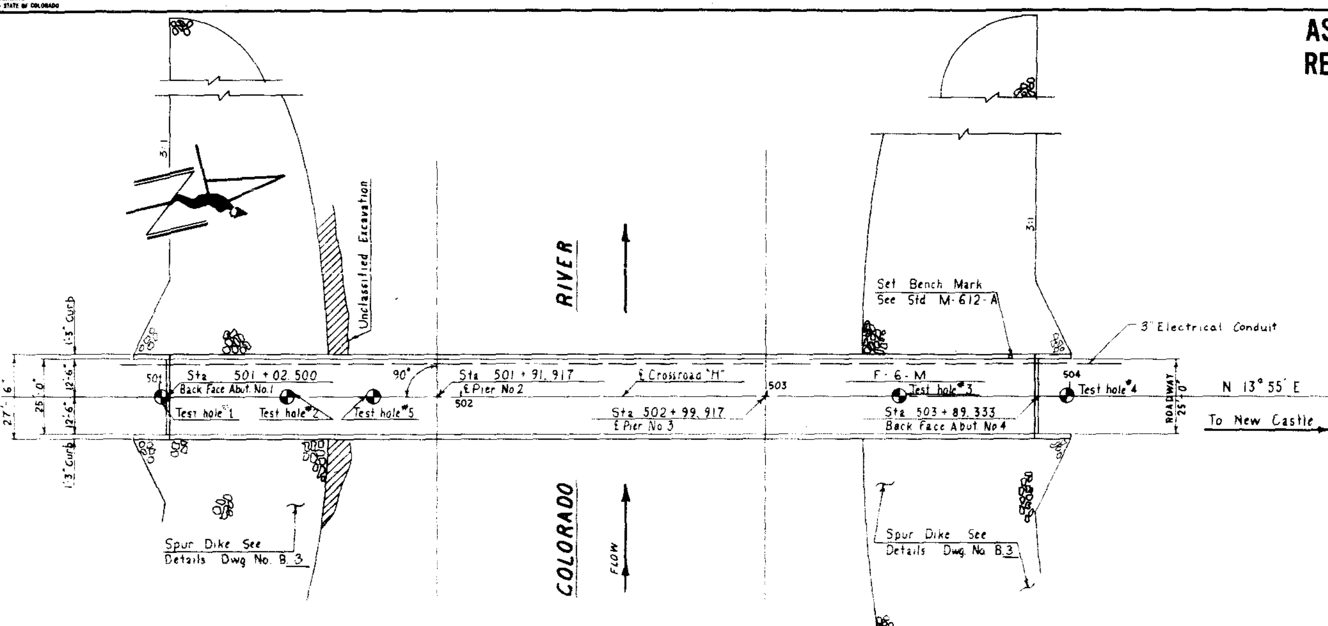
STATE DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS – STATE OF COLORADO
FORM D.O.H. 117
JULY, 1968

AS CONSTRUCTED
REVISED DATE DEC 23 1971

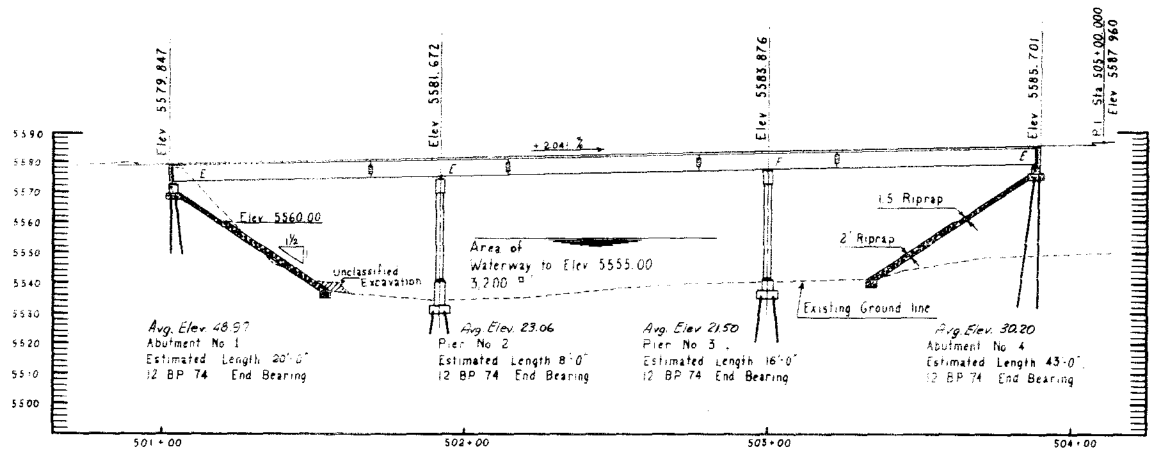
FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO	I-70-1(27)105	51	234

REVISIONS

DESIGNED BY	F.W.G.		CHECKED BY	R.W.G.	B-69
CHECKED BY			QUANTITIES BY	D.R.	B-69
DETAILED BY	R.J.S.	B-69	CHECKED BY	D.R.	B-69



·PLAN·



Q50 = 47,500 CFS.
DA = 6,630 Sq. Mi.

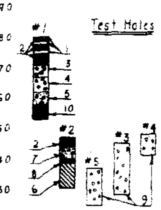
·ELEVATION·
(Taken at Center line of Bridge)

GENERAL LAYOUT

HYDRAULICS

Q 50 47,500 CFS
DA 6,630 Sq. M

Test Holes



1 Soil
2 Sandstone Boulders
3 Soil, Broken Rock
4 Broken Rock, Small Boulders
5 Sandstone
6 Argillaceous Sandstone
7 River Boulders, Gravel
8 Arenaceous Shale
9 Sand, Gravel, Boulders
10 Fractured Standstone

For Summary of Quantities see Dwg. No. B-2
For Riprap Details see Dwg No B.-3

3-Spans (87'-6" - 108'-0" - 87'-6") Continuous Concrete Slab and Welded Steel Girder Bridge.

Crossroad "H" over Colorado River
Roadway: 25'-0" Skew: 90°
1'-3" Curbs, Std Galvanized Bridge Rail

GENERAL NOTES

ALL WORK SHALL BE DONE ACCORDING TO THE STANDARD SPECIFICATIONS OF THE DEPARTMENT OF HIGHWAYS, STATE OF COLORADO, APPLICABLE TO THE PROJECT.

EACH REINFORCING BAR SHALL BE TAGGED WITH THE BAR DESIGNATION, STRUCTURE NUMBER, AND STATION OF THE PROJECT.

IF BY PERMISSION OF THE ENGINEER PRIMARY BARS ARE SPLICED, THEY SHALL LAP A MINIMUM OF 40 DIAMETERS FOR BARS NEAR TOPS OF BEAMS HAVING MORE THAN 12 INCHES OF CONCRETE UNDER THE BARS, AND 24 DIAMETERS FOR BARS NEAR THE BOTTOMS OF MEMBERS. SECONDARY BARS SHALL LAP 24 DIAMETERS WHEN SPLICED.

DIMENSIONS FOR REINFORCING STEEL NOT SHOWN AS CLEAR SHALL BE TO THE CENTERLINE OF THE BAR.

ALL CONCRETE SURFACES MARKED WITH THE SYMBOL AS SHOWN ON DRAWING NO. B-3 SHALL RECEIVE CLASS 2 SURFACE FINISH.

ALL CONCRETE CHAMFERS SHALL BE 3/4" UNLESS OTHERWISE NOTED.

EXPANSION JOINT MATERIAL SHALL MEET AASHO SPECIFICATION M-213-65 UNLESS OTHERWISE NOTED.

SOUNDINGS AND DEPTH OF FOOTINGS ARE IN ACCORDANCE WITH THE BEST AVAILABLE DATA. WHEN DIFFERENT CONDITIONS ARE ENCOUNTERED, THE BRIDGE ENGINEER WILL INSPECT AND DETERMINE IF REDESIGN IS NECESSARY.

WHEN TREATED TIMBER PILING IS SHOWN ON THE PLANS, THE PRESERVATIVE FOR TREATMENT SHALL BE CREOSOTE OIL.

WHEN EXCAVATING FOR FOOTINGS THE FINAL SIX INCHES IN DEPTH SHALL BE DONE BY HAND-LABOR METHODS.

FOR DETAILS OF STRUCTURE EXCAVATION AND STRUCTURE BACKFILL, SEE STANDARD M-206-A.

ALL STRUCTURAL STEEL NOT OTHERWISE NOTED SHALL BE AASHO SPECIFICATION M-183.

WELDING SHALL CONFORM TO THE LATEST EDITION OF THE AWS STANDARD SPECIFICATIONS FOR WELDING HIGHWAY BRIDGES AS AMENDED.

FOR WELDED GIRDERS, ALL SHOP BUTT WELDS IN FLANGES AND WEBS SHALL BE MADE BEFORE WELDING INTO GIRDER. SHOP WELDS SHALL BE INSPECTED RADIOGRAPHICALLY OR BY THE PENETRANT DYE METHOD.

ALL STRUCTURAL STEEL NOT OTHERWISE NOTED SHALL BE PAINTED IN ACCORDANCE WITH SECTION 509 FOR (GREEN) PAINT.

NO WELDING OF ANY KIND SHALL BE PERMITTED ON THE FLANGES OF STEEL GIRDERS UNLESS SPECIFICALLY CALLED FOR ON THE PLANS.

BOLTS SHALL BE FURNISHED IN THE AMOUNT OF TWO PERCENT IN EXCESS OF THE NOMINAL NUMBER REQUIRED FOR EACH SIZE AND LENGTH.

ALL BOLTS SHALL BE 3/4" DIAMETER, HIGH-TENSILE STRENGTH UNLESS OTHERWISE NOTED.

LOADING DATA

LIVELOAD: AASHO HS-20-44

DEADLOAD: ASSUMES 15 LBS. PER SQ. FT. ADDITIONAL WEARING SURFACE WHICH INCLUDES THE ½ INCH CONCRETE MONOLITHIC WEARING SURFACE SHOWN.

DESIGN DATA

AASHO UNIT STRESSES EXCEPT AS NOTED.

REINFORCING STEEL: GRADE 40 Fs = 20,000 LBS. PER SQ. IN.; GRADE 60 Fs = 24,000 LBS. PER SQ. IN.

STRUCTURAL STEEL: A36, Fs = 20,000 LBS. PER SQ. IN.; A572, Fs = 27,000 LBS. PER SQ. IN.

CONCRETE: Fc = 1,200 LBS. PER SQ. IN.; n = 10

BRIDGE SECT. D.O.H. FEB 1970

Rev. PC 2-18-70

PLANS BY BSMcH & D.O.H.

DIVISION OF HIGHWAYS

GENERAL NOTES
GENERAL LAYOUT

STATION: 501+02.500 TO 503+89.333
NEAR: NEW CASTLE SEC. 2-32 T 5-6 S R 90-91 W

Approved:	Designer: P.W.G.	Detailer: Seylhouer
Bridge Engineer	Structure Numbers	F-6-M
Date.	DWG. No. B 1 OF 11	

STATE DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS — STATE OF COLORADO
FORM D.O.H. 117
JULY, 1968

AS CONSTRUCTED
REVISED DATE DEC 23 1971

FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO	I-70-1(27) 105	52	234

REVISIONS

Bar List - Pier No. 2

MARK	NO. REQ.D	LENGTH	TYPE	DIMENSIONS l	DIMENSIONS m
415	4	2'-9"	Str		
416	4	2'-6"	VIII		
417	6	6'-3¾"	VII	1'-4½"	4'-3¾"
418	14	2'-8"	Str		
420	87	9'-5"	II	1'-11½"	2'-3"
421	58	5'-6½"	VII	1'-1½"	3'-6½"
422	16	7'-1¼"	VII	1'-7½"	5'-1¼"
423	16	12'-5"	II	2'-5½"	3'-3"
506	12	14'-4"	II	4'-3"	2'-5"
507 to 513	4 ea.	14'-[illegible] B.E.I. 11'-9½"	II	4'-1½" B.E.I. 2'-11¾"	2'-5"
514	27	6'-6"	Str		
80[illegible]		14'-8"			
[illegible]	4	[illegible]			
[illegible]	2	[illegible]			
[illegible]	2	[illegible]			
[illegible]	2	[illegible]			
[illegible]	26	[illegible]			
[illegible]	54	[illegible]			
[illegible]06	28	7'-8"	Str		

Summary

[illegible] Lin Ft #4 Bar @ [illegible] Lbs/Lin Ft = [illegible] Lbs
[illegible] Lbs
[illegible] = 430 Lbs
78 Lin Ft [illegible] = [illegible] Lbs
[illegible] Lbs
Total = [illegible] Lbs

Bar List - Pier No. 3

MARK	NO. REQ.D	LENGTH	TYPE	DIMENSIONS l	DIMENSIONS m
415	4	2'-9"	Str		
416	4	2'-6"	VIII		
417	6	6'-3¾"	VII	1'-4½"	4'-[illegible]¼"
418	14	2'-8"	Str		
420	36	9'-5"	II	1'-11½"	2'-3"
421	64	5'-6½"	VII	1'-1½"	3'-6½"
422	8	7'-1¼"	VII	1'-7½"	5'-1¼"
423	8	[illegible]	II	2'-5½"	[illegible]
506	12	14'-4"	II	4'-3"	2'-5"
507 to 513	4 Ea.	14'-[illegible] B.E.I. [illegible]	II	4'-[illegible] B.E.I. [illegible]	2'-5"
514	27	6'-8"	Str		
80[illegible]		14'-8"			
[illegible]	4	[illegible]			
[illegible]	8	[illegible]			
[illegible]	4	[illegible]			
[illegible]	[illegible]	[illegible]			
[illegible]	26	[illegible]			
[illegible]	54	[illegible]			
[illegible]	46	[illegible]	Str		

Summary

[illegible]
Total = [illegible] Lbs

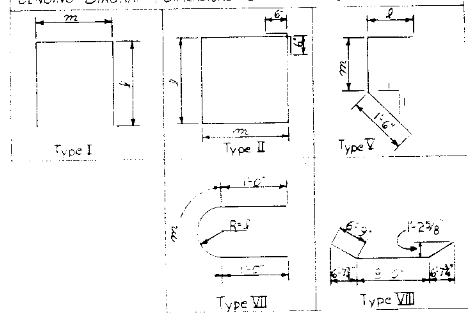
Bar List - Superstructure

MARK	NO. REQ.D	LENGTH	TYPE	DIMENSIONS l	DIMENSIONS m
401	284	4'-9"	Str		
402	568	2'-3"	I	0'-[illegible]	0'-11"
403	246	40'-0"	Str		
404	76	5'-0"	II	1'-2"	0'-10"
406	41	50'-0"	Str		
502	1138	27'-2"			
503	72	60'-0"			
515	18	49'-0"			
701	48	39'-2"			
702	48	19'-2"	Str		

Summary

[illegible] Lin Ft #4 Bar @ [illegible] Lbs/Lin Ft = 10,141 Lbs
36,118 Lin Ft #5 Bar @ 1.043 Lbs/Lin Ft = 37,671 Lbs
[illegible] Lin Ft #7 Bar @ [illegible]44 Lbs/Lin Ft = 5,740 Lbs
Total = 53,552 Lbs

Bending Diagram (Dimensions Out To Out Of Bar)



[illegible]

MARK	NO. REQ.D	LENGTH	TYPE	DIMENSIONS l	DIMENSIONS m
404	4	5'-[illegible]	II	[illegible]	[illegible]
405	12	4'-[illegible]	I	[illegible]	2'-4"
407	24	13'-6"	II	4'-8"	[illegible]
408	24	[illegible]	I	[illegible]	2'-[illegible]
40[illegible]	6	[illegible]	Str		
[illegible]	38	[illegible]	[illegible]	[illegible]	[illegible]
4[illegible]	42	[illegible]	[illegible]		
4[illegible]	[illegible]	[illegible]	Str		
4[illegible]	24	4'-[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]		
504	25	3'-4"			
[illegible]	7	8'-6"			
[illegible]	5	[illegible]			
[illegible]02	52	[illegible]			
[illegible]	8	[illegible]			
[illegible]	2	[illegible]			

Summary

[illegible] Lin Ft #4 Bar @ [illegible] Lbs/Lin Ft = 1,28[illegible] Lbs
375 Lin Ft #5 Bar @ [illegible]043 Lbs/Lin Ft = 394 Lbs
[illegible] Lin Ft #6 Bar @ [illegible] Lbs/Lin Ft = 473 Lbs
[illegible] Lin Ft #9 Bar @ [illegible]400 Lbs/Lin Ft = [illegible]105 Lbs
Total = 4,256 Lbs

The First Digit or Digits [illegible] of the Reinforcing Bar Designation indicates the Bar Size. Example: [illegible] #4 Bar [illegible]

[illegible] By Equal Increments

See Book 12 Page 13

Summary of Quantities

ITEM NO	DESCRIPTION	UNIT	SUPER-STRUCT	ABUT NO 1	PIER NO 2	PIER NO 3	ABUT NO 4	TOTAL
203	Unclassified Excavation	Cu Yds						55
[illegible]	Structure Excavation	Cu Yds		[illegible]	[illegible]	[illegible]	300	695
[illegible]	[illegible] (Class B)	Cu Yds		45	30	[illegible]	45	155
[illegible]	[illegible]	[illegible]		82 * + 9 ~~70~~	64	116 ~~128~~	180 * + 9 ~~72~~	454 ~~444~~
[illegible]	[illegible] ⌀	Cu Yds		154 ~~350~~			135 ~~430~~	692 ~~840~~
[illegible]	[illegible] ⌀	[illegible]		352 ~~460~~			350 ~~640~~	2390
[illegible]	[illegible]	[illegible]	[illegible]					198,984
[illegible]	[illegible]	[illegible]	[illegible]					23,052
[illegible]	[illegible]	[illegible]	2					2
[illegible]	[illegible]	[illegible]	990					990
[illegible]	[illegible] Class A	Cu Yds		[illegible]	[illegible]	[illegible]	[illegible]	175
[illegible]	[illegible]	Cu Yds	[illegible]					202
[illegible]	Reinforcing Steel	Lbs	[illegible]	4,536	[illegible]	10,464	4,05[illegible]	83,320
① [illegible]	3" Electrical Conduit	Lin Ft	288					288

① Non Federal Aid Reimbursable By Mountain States T&T. See Note Dwg. No B-6

* For welds

⌀ No pay item. Force Account under C.O. No 22633. Included in Riprap Tabulations

INITIAL	DATE	
R.W.G.	8-62	DESIGNED BY
D.L.R.	8-62	CHECKED BY
D.L.R.	8-62	DETAILED BY
R.W.G.	8-62	CHECKED BY
C.L.B.	8-63	QUANTITIES BY / CHECKED BY

DIVISION OF HIGHWAYS

Summary of Quantities - Bar List, Bending Diagram

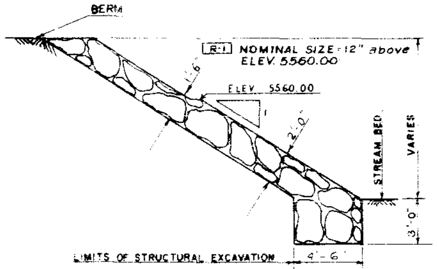
Approved:
Bridge Engineer
Date

Designer: R.W.G. Detailer: B.J.D.
Structure Numbers: F-6-M
DWG. No. B-2 of 11

REVISIONS

FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	I-70-1(27)105	53	

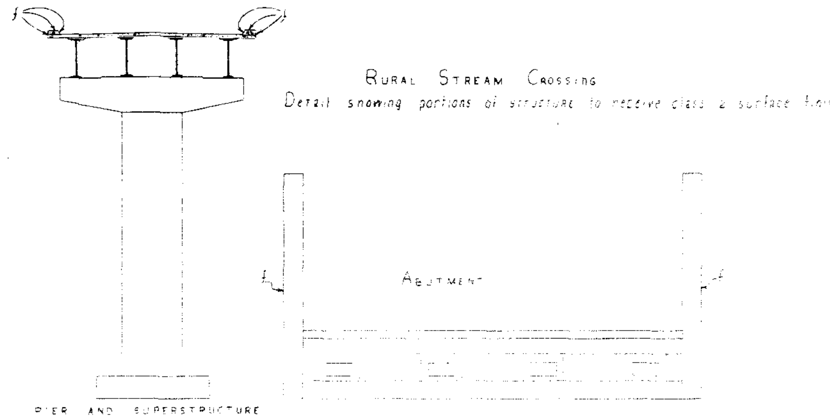
R-1 Rev. 3-13-70 W.E.M.

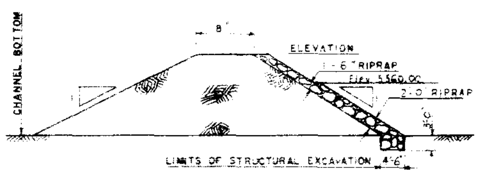


DETAIL OF RIPRAP WITH TOE

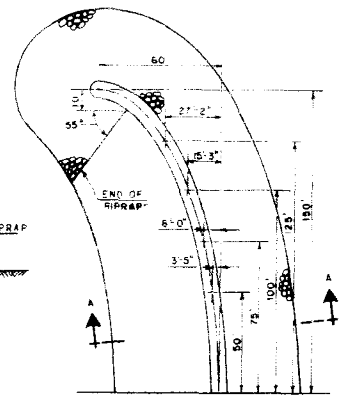
NOTES:
TRANSITION ENDS OF RIPRAP MAY BE MODIFIED BY THE ENGINEER TO FIT CONDITIONS ENCOUNTERED IN THE FIELD.

R-1 NOMINAL SIZE 18" below ELEV. 5560.00



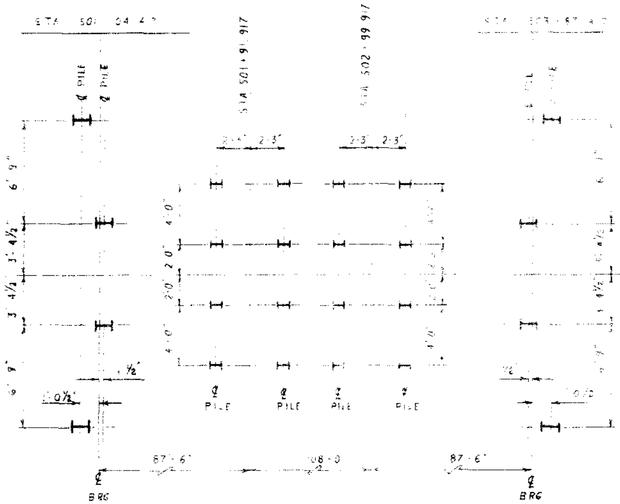


SECTION A - A



PLAN

DETAIL OF SPUR DIKE



PILING LAYOUT

TA 110-20 57

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO
SPUR DIKE DETAILS
SURFACE FINISH
PILE LAYOUT

Across COLORADO RIVER
Sta. 500 TO 503+89.333
Near NEW CASTLE Sec. 2-32 T. 5-6S R.90-1W

Designed by FWG	Approved by
Made by BJD.	Bridge Engineer
Checked by	Date: 19

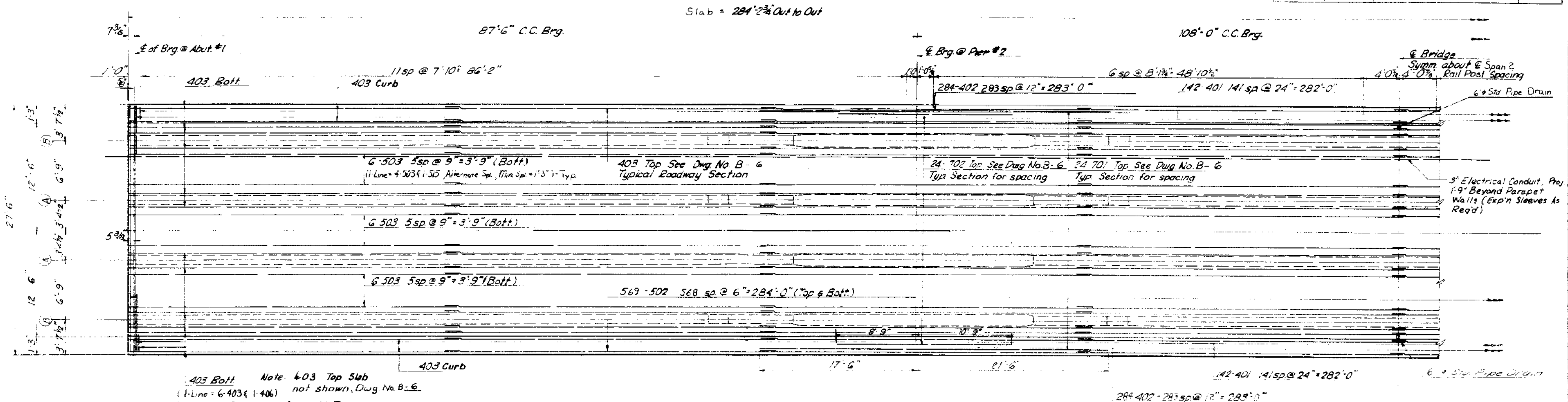
STRUCTURE NO. F-6-M

DWG. No. B 3 OF 11

REVISIONS

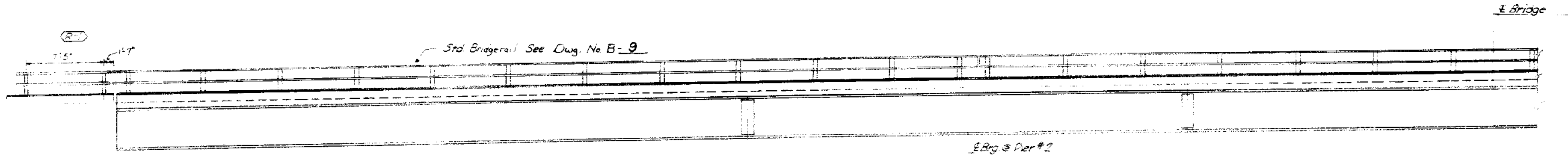
	Date	Revision	By
R-1	6-12-70	Revised Wingwall Bridgerail Dimen.	TCF

FEDERAL ROAD REGION No.	DIVISION	PROJECT No.	SHEET No.
9	COLORADO	I-70-1(27)105	54



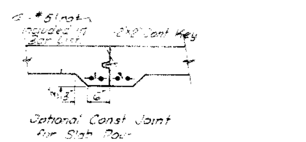
HALF DECK PLAN (SYMM ABOUT ℄ SPAN 2)

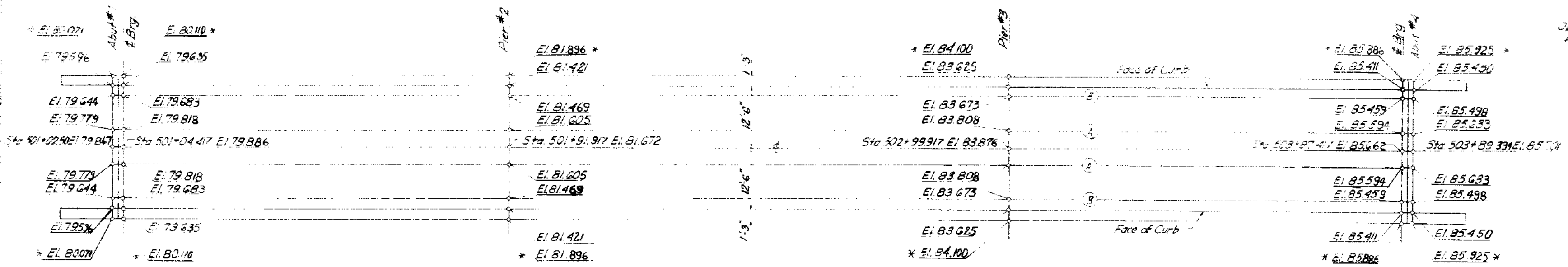
3/16" = 1'-0"



HALF RAIL ELEVATION

3/16" = 1'-0"





FINISHED ROADWAY ELEVATIONS

(Except Those Marked * Which Are Top Of Curb.)

All scales shown are Original Scale

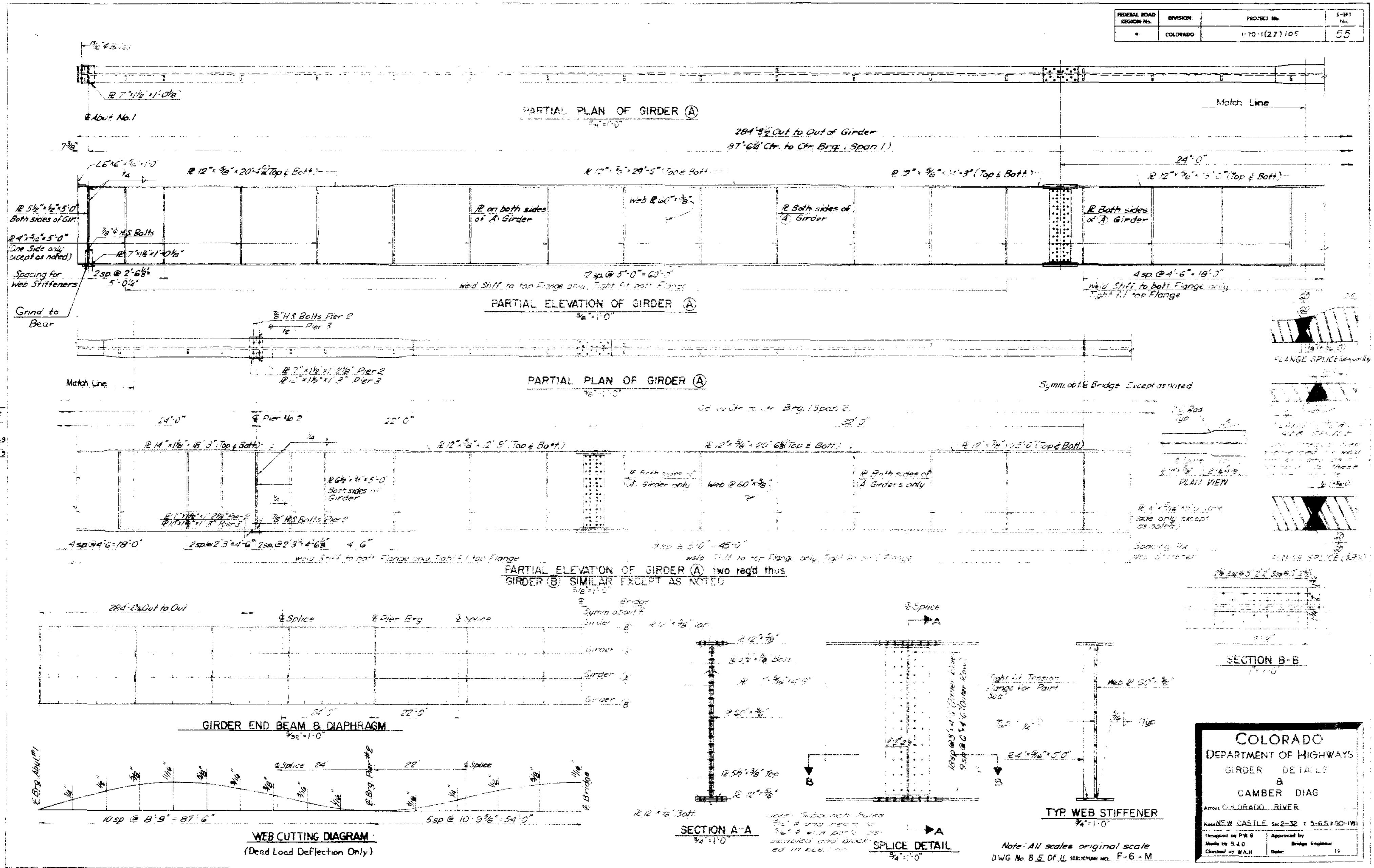
DWG. No. B-4 OF 11   STRUCTURE NO. F-6-M

COLORADO
DEPARTMENT OF HIGHWAYS
DECK PLAN & ELEVATION

Across COLORADO RIVER
Near NEW CASTLE Sec 2-32 T. 5-S R. 90-W

Designed by P.W.G.
Made by B.J.D.
Checked by W.A.H.
Approved by Bridge Engineer
Date: 19

REVISIONS

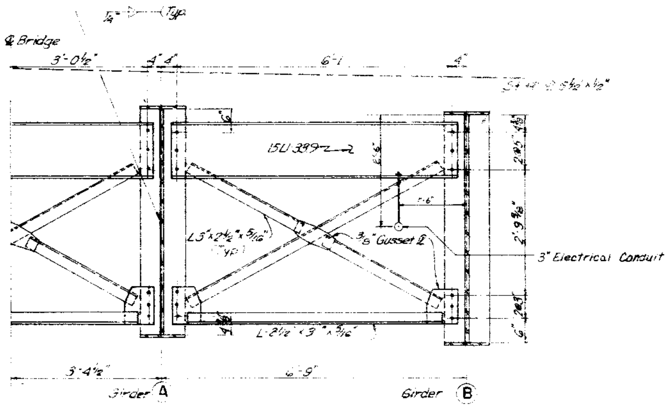


FEDERAL ROAD REGION No. 9
DIVISION COLORADO
PROJECT No. I-70-1(27)105
SHEET No. 55
PARTIAL PLAN OF GIRDER (A)
¢ Abut No. 1
Match Line
284'-8½" Out to Out of Girder
87'-6¼" Ctr. to Ctr. Brg. (Span 1)
24'-0"
⅞" ¢ H.S. Bolts
Spacing for Web Stiffeners
Grind to Bear
12 sp. @ 5'-0" = 60'-0"
4 sp. @ 4'-6" = 18'-0"
Weld Stiff. to bott. Flange only. Tight fit top Flange
PARTIAL ELEVATION OF GIRDER (A)
⅞" H.S. Bolts Pier 2
PARTIAL PLAN OF GIRDER (A)
Symm. abt. ¢ Bridge Except as noted
¢ Pier No. 2
24'-0"
22'-0"
Web ℙ 60" x ⅜"
PLAN VIEW
FLANGE SPLICE
PARTIAL ELEVATION OF GIRDER (A) two req'd thus
GIRDER (B) SIMILAR EXCEPT AS NOTED
SECTION B-B
284'-2½" Out to Out
¢ Splice
¢ Pier Brg.
Girder B
Girder A
GIRDER END BEAM & DIAPHRAGM
3/32" = 1'-0"
¢ Brg. Abut. #1
¢ Brg. Pier #2
¢ Bridge
10 sp. @ 8'-9" = 87'-6"
5 sp. @ 10'-9⅝" = 54'-0"
WEB CUTTING DIAGRAM
(Dead Load Deflection Only)
SECTION A-A
¾" = 1'-0"
SPLICE DETAIL
¾" = 1'-0"
TYP. WEB STIFFENER
¾" = 1'-0"
Note: All scales original scale
DWG No. 8.5 OF 11 STRUCTURE NO. F-6-M
COLORADO
DEPARTMENT OF HIGHWAYS
GIRDER DETAILS
&
CAMBER DIAG.
COLORADO RIVER
NEW CASTLE Sec. 2-32 T. 5-6 S. R. 90-1 W.
Designed by P.W.G.
Made by B.J.O.
Checked by W.A.H.
Approved by Bridge Engineer

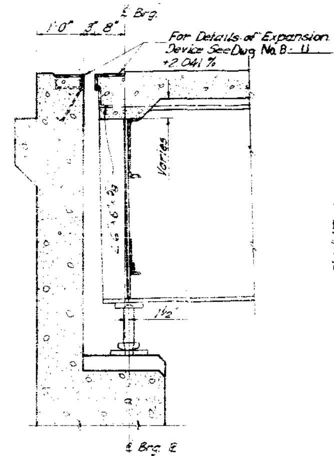
REVISIONS

FEDERAL ROAD REGION No.	DIVISION	PROJECT No.	SHEET No.
9	COLORADO	I-70-1(27)105	56

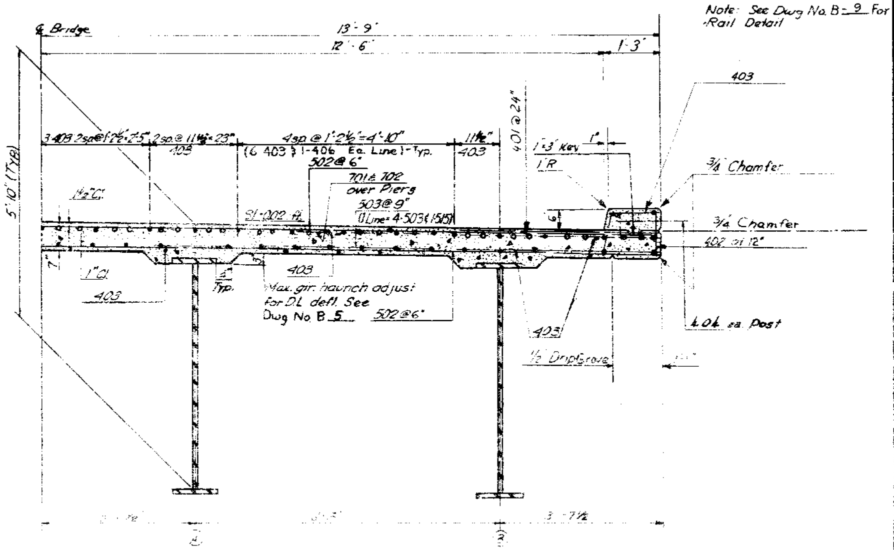
Note: See Dwg No. B-9 For Rail Detail



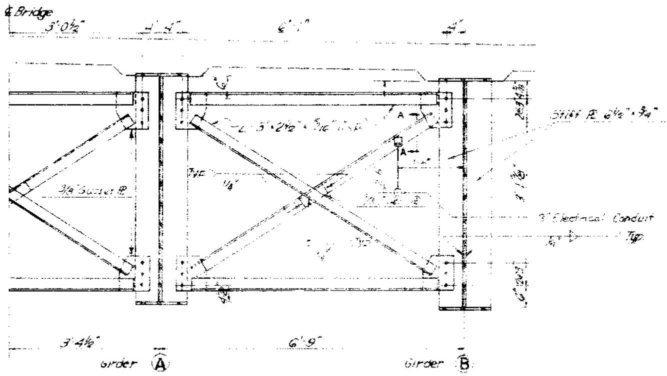
SECTION AT END BEAMS (ABUT.)
¾"-1'-0"



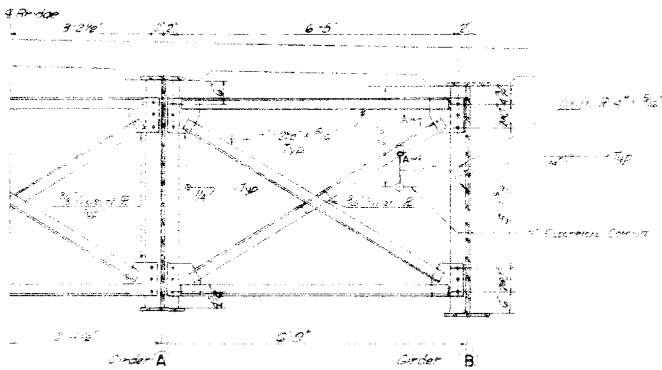
SECTION AT ABUTMENT ①



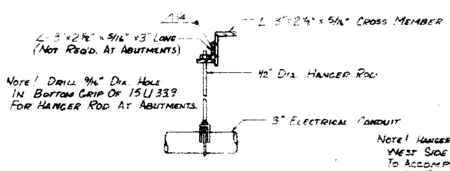
TYPICAL SECTION



SECTION AT PIER CROSS FRAME
¾"-1'-0"



SECTION AT INTERMEDIATE CROSS FRAME
¾"-1'-0"



Note: Drill 9/16" Dia. Hole In Bottom Grip Of 15U 33.9 For Hanger Rod At Abutments.

SECTION A-A

Note: Hangers Spaced At 20'-0" ± (14 Req'd) West Side Only. All Work Necessary To Accomplish The Above Shall Be Included In The Bid Price For Item 613, 3" Electrical Conduit. The Contractor Shall Notify Mtn. States Tel. & Tel. Co. And Arrange Inspection Of Conduit Placement. Work To Be Done By The Contractor (Non-Fed. Aid). M.S.T. & T. Co. To Reimburse The Highway Dept. For This Work.

Note: All scales shown are Original Scale

DWG No B 6 OF 11 STRUCTURE NO. F-6-M

COLORADO
DEPARTMENT OF HIGHWAYS
MISCELLANEOUS DETAILS

Across COLORADO RIVER
Near NEW CASTLE Sec. 2-32 T. 5-6S R. 90-1W

Designed by P.W.G. Made by B.J.D. Checked by W.A.H.
Approved by Bridge Engineer Date: 19

PWG
BJD
RWG 8-69
DR 8-69

FED. ROAD DIV. NO.	STATE	PROJ. NO.	SHEET NO	TOTAL SHEETS
9	COLO.	S 0143(2)	1	

Rev. - Index of Sheets - 2-3-49 CJW.

143.62

COLORADO
STATE HIGHWAY DEPARTMENT

PLAN AND PROFILE OF PROPOSED
FEDERAL AID SECONDARY PROJECT NO. S 0143(2)
STATE HIGHWAY NO. 340
MESA COUNTY

INDEX OF SHEETS

CONVENTIONAL SIGNS

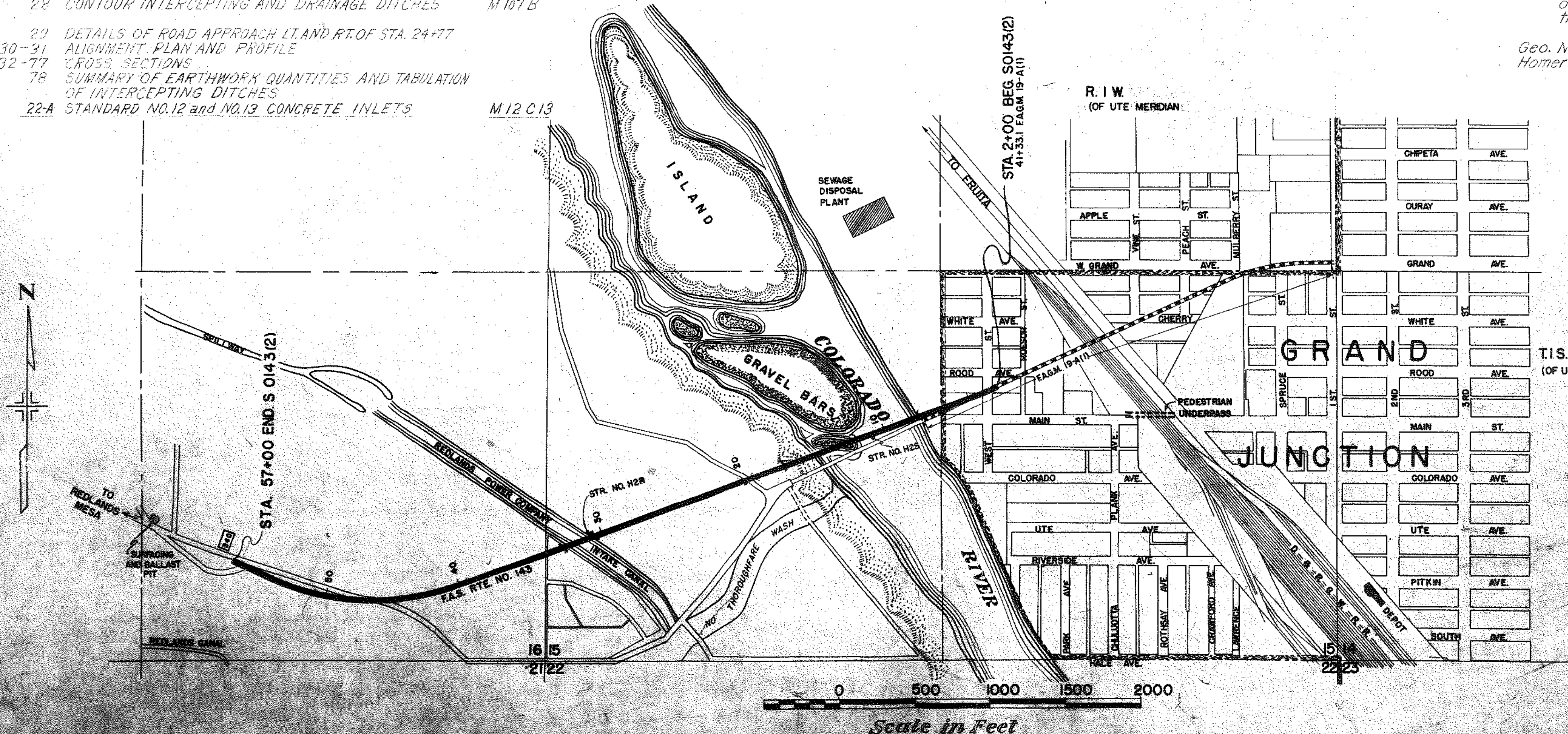
CENTER LINE OF SURVEY
RIGHT OF WAY LINE
SECTION LINE
ONE QUARTER SECTION LINE
CITY LIMITS
BARBED WIRE FENCE
COMBINATION WIRE FENCE
BOARD FENCE
WATER PIPE LINE
SEWER PIPE LINE
TELEPH. & TELEG. LINE
POWER LINE
RAILROADS

SCALES OF ORIGINAL TRACINGS
ON PLAN, 1 IN. - 100 FT.
ON PROFILE 1 IN. - 100 FT. HORIZONTAL
1 IN. - 10 FT. VERTICAL
GRADE LINE ON PROFILE IS SHOWN AS GRADE OF FINISHED ROAD
GROSS LENGTH OF PROJECT
NET LENGTH OF PROJECT } 5490 FEET = 1.039 MILES

NOTE:

It is recommended that bidders on this Project go over the plan details with one of the following field representatives of this Department.

Geo. N. Miles - District Engineer - Grand Junction, Colo.
Homer Gray - Construction Engineer - Grand Junction, Colo.



RECOMMENDED FOR APPROVAL
Jas. H. Bell
ASSISTANT ENGINEER DATE 12-29-48

APPROVED
Mark U. Watrous
STATE HIGHWAY ENGINEER DATE 12-30-48

RECOMMENDED FOR APPROVAL DATE
DISTRICT ENGINEER
PUBLIC ROADS ADMINISTRATION
FEDERAL WORKS AGENCY

APPROVED DATE
DIVISION ENGINEER
PUBLIC ROADS ADMINISTRATION
FEDERAL WORKS AGENCY

REVISIONS

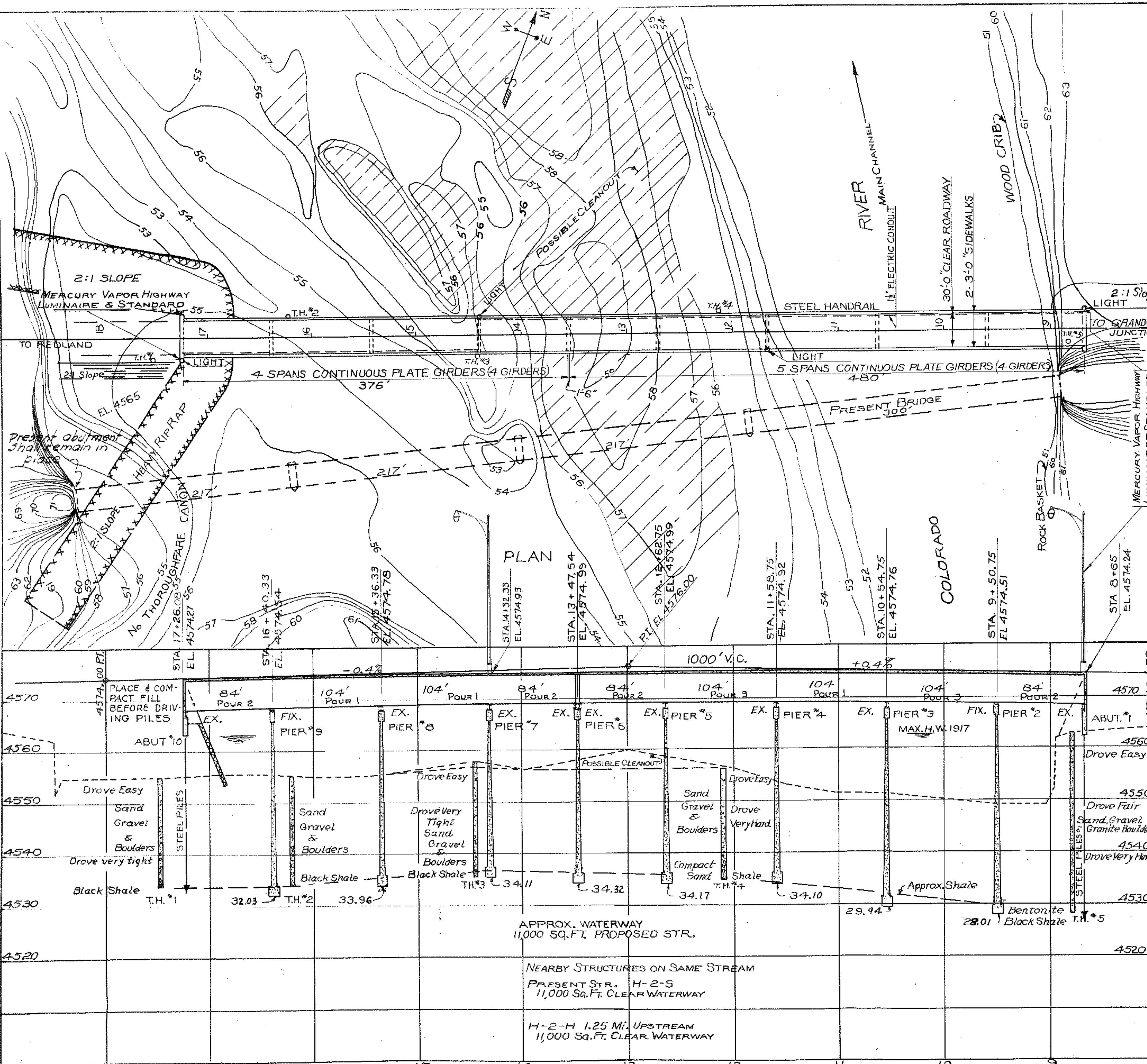
REV. 4-30-48 E.F.W. Raised Grade 2'-0"
Rev. Detail of Riprap 2-3-49 C.J.W.
Rev. Footing Elev. Pier 1, 4-5-4-15-49 B.D.L.
Rev. 6-15-49 A.F.H. Delete Sheet Metal
Rev. 7-20-49 A.F.H. Raised Handrail

FED. ROAD DIST. NO.	STATE	PROJ. Nº	SHEET NO.	TOTAL SHEETS
3	COLO.	S 0143 (2)	7	

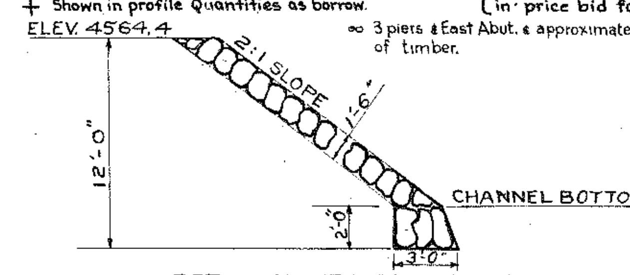
SUMMARY OF QUANTITIES

ITEM Nº		UNIT	SUPERST STRUCTURE	ABUT. Nº 1	PIER Nº 2	PIER Nº 3	PIER Nº 4	PIER Nº 5	PIER Nº 6	PIER Nº 7	PIER Nº 8	PIER Nº 9	ABUT. Nº 10	TOTAL
13c	UNCLASSIFIED EXCAVATION	CU.YD												+
14a	DRY ROCK EXCAVATION (STR.)	CU.YD						5						5
14b	DRY COMMON EXCAVATION (STR.)	CU.YD		9				83	70	53	26	38	98	377
14c	WET ROCK EXCAVATION (STR.)	CU.YD			20	23	9	20	15	23	44	24		178
14d▷	WET COMMON EXCAVATION (STR.)	CU.YD			395	374	350	320	312	300	333	380	49	2813
16a	STRUCTURE BACKFILL CLASS I	CU.YD.		156	300	271	260	350	277	285	273	319	186	2677
16d	MECHANICAL TAMPING	HR.		16	30	27	26	35	28	29	27	32	19	269
42a	UNTREATED BRIDGE TIMBER	M.FT. B.M.		0.12									0.12	0.24
46a	CLASS "A" CONCRETE	CU.YD	797	33	172	154	133	133	136	133	133	148	33	2005
47	REINFORCING STEEL	LB.	158,700	2600	10240	6470	5630	5630	5970	5630	5630	7700	2600	216,800
48	STRUCTURAL STEEL	LB.	1,093,470	645	845	845	845	845	845	845	845	845	645	1,102,520
61a	STEEL PILING (12" CBP @ 53#)	Lin.Ft		365									311	676
67b	HEAVY RIPRAP	CU.YD											443	443
80c	SHEET COPPER - 32 OZ.	LB.	18											18
89a	DRAIN PIPE (CONCRETE FLOOR) 4"ø x 2'-0"	EACH	82											82
▫90	1½" ELECTRICAL CONDUIT & JCN. BXs.	Lin.Ft.	926	4									4	934
98a	LIGHT STANDARD COMPLETE	EACH	2	1									1	4
98c	HIGHWAY LUMINAIRE	EACH	2	1									1	4
✦	TELEPHONE CABLE SUPPORTS	EACH	8											8
*	½" EXP'N. JT. MAT'L	SQ.FT	220											220
*	3"ø x 1'-0" IRON PIPE	EA.		2									2	4
✦	⅝"ø x 14" THIMBLE EYE BOLTS	EA.		4									4	8

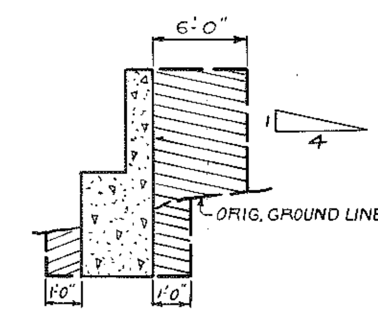
▷ ASSUMED WET LINE 4554.0
ø INCLUDES 70,320 LBS. FOR HANDRAIL
* INCLUDE IN PRICE BID FOR CLASS "A" CONCRETE
▫ Max. Spacing of outlet boxes shall be no more than 150 ft. 1-Exp'n. Coupling Req'd.
✦ Furnished by Grand Junction Telephone office. {Installation of portions of Telephone Cable Support to be included in price bid for CLASS "A" CONCRETE. See Note on Sheet Nº 10.
+ Shown in profile Quantities as borrow.
∞ 3 piers & East Abut. & approximately 560,300# of structural steel & 129,000 bd ft. of timber.



GENERAL LAYOUT



DETAIL OF HEAVY RIPRAP



STRUCTURE BACKFILL DIAGRAM

REFERENCE DRAWINGS

SHEET Nº 8 DETAILS OF SUPERSTRUCTURE
SHEET Nº 9 " " "
SHEET Nº 10 DETAILS OF SUPERSTR. EXP'N DEVICES & BEARINGS
SHEET Nº 11 DETAILS OF PLATE GIRDERS
SHEET Nº 12 DETAILS OF ABUTS. Nº 1 & Nº 10 & BAR LISTS.
SHEET Nº 13 DETAILS OF PIERS Nº 2 & Nº 3
SHEET Nº 14 DETAILS OF PIERS Nº 4, 5, 6, 7, 8, & 9

LOADING DATA.

LIVE LOAD A. A. S. H. O. H-20-44
DEAD LOAD ASSUMES 15 LBS. PER SQ. FT. ADDITIONAL WEARING SURFACE WHICH INCLUDES THE ½ INCH CONCRETE MONOLITHIC WEARING SURFACE SHOWN.

DESIGNING DATA.

Structural Steel f_r = 1000 lbs. per sq. in. f_s = 18000 lbs. per sq. in.
Reinforcing Steel f_s = 20,000 lbs. per sq. in.
n = 10

GENERAL NOTES

ALL WORK SHALL BE DONE ACCORDING TO THE STANDARD SPECIFICATIONS OF THE COLORADO STATE HIGHWAY DEPARTMENT.

ALL CONCRETE SHALL BE CLASS "A."

FORMS FOR CONCRETE SURFACES EXPOSED IN THE FINISHED WORK SHALL BE CONSTRUCTED OF SHIPLAP OR TONGUE AND GROOVE LUMBER S3S UNLESS FACED WITH PANEL BOARD.

CONCRETE GIRDERS, FLOOR SLABS AND CURB SHALL BE POURED MONOLITHICALLY.

FOOTINGS IN ROCK SHALL BE POURED OUT TO THE ROCK AND NOT FORMED.

ALL REINFORCING BARS SHALL BE INTERMEDIATE GRADE.

ALL REINFORCING BARS SHALL BE DEFORMED AND TAGGED WITH THE STATION NUMBER AND LETTER DESIGNATION. MAIN BARS SHALL NOT BE SPLICED.

SOUNDINGS AND DEPTH OF FOOTINGS SHOWN ARE ACCORDING TO THE BEST AVAILABLE DATA. IF ESSENTIALLY DIFFERENT CONDITIONS ARE ENCOUNTERED THE BRIDGE ENGINEER WILL INSPECT AND DETERMINE IF REDESIGN IS NECESSARY.

ALL RIVETS TO BE ¾" DIA. ALL RIVETS TO BE POWER DRIVEN.

ALL CONCRETE SURFACES EXPOSED TO VIEW SHALL BE GIVEN CLASS I SURFACE FINISH, EXCEPT UNDERSIDE OF FLOOR SLABS, AND ABUTMENT FACES BELOW STRINGERS.

ALL STRUCTURAL STEEL TO BE GIVEN ONE SHOP COAT OF ZINC CHROMATE & TWO FIELD COATS OF ALUMINUM PAINT.

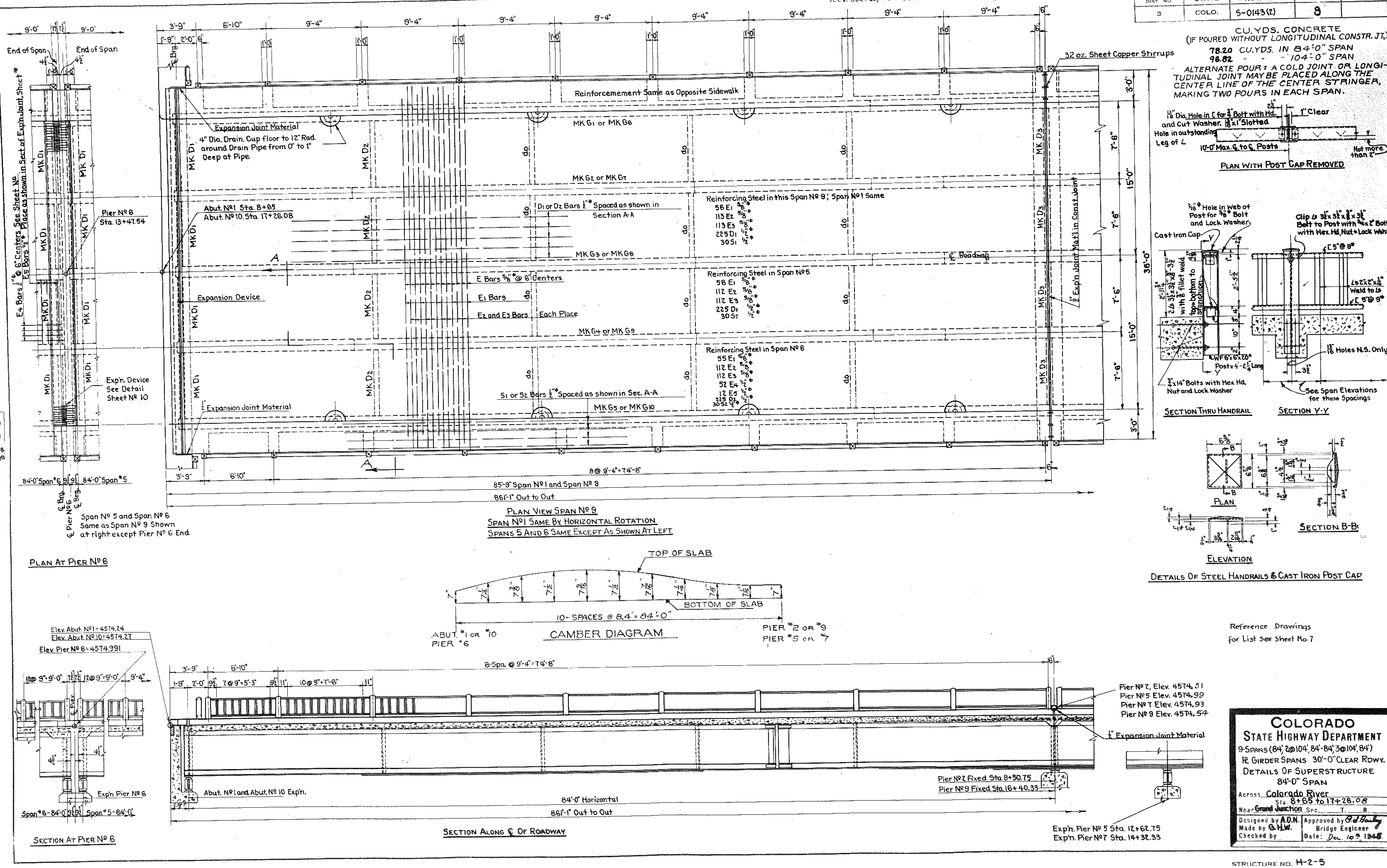
COLORADO
STATE HIGHWAY DEPARTMENT
9-SPANS (84', 2@104', 84', 84', 3@104' & 84') PL GIRDER SPANS
30'-0" CLEAR ROADWAY
GENERAL LAYOUT AND SUMMARY OF QUANTITIES
Across COLORADO RIVER
Sta. 8+65.00 to 17+26.08
Near GRAND JUNCTION Sec. 15 T. 1 S. R. 100 W.

Designed by ADN	Approved by G. S. Bailey, Bridge Engineer
Made by EFW	
Checked by	Date: Dec. 10th, 1948

STRUCTURE NO. H-2-S

FED. ROAD DIST. NO.	STATE	PROJ. NO.	SHEET NO.	TOTAL SHEETS
3	COLO.	S-0143(2)	8	

Rev. July 20, 49 Raised Handrail 9½" R.H.



COLORADO
STATE HIGHWAY DEPARTMENT
9-SPANS (84', 2@104', 84'-84', 3@104', 84')
Ɍ GIRDER SPANS 30'-0" CLEAR ROWY.
DETAILS OF SUPERSTRUCTURE
84'-0" SPAN

Across Colorado River
Sta. 8+85 to 17+26.08
Near Grand Junction Sec. T. R.

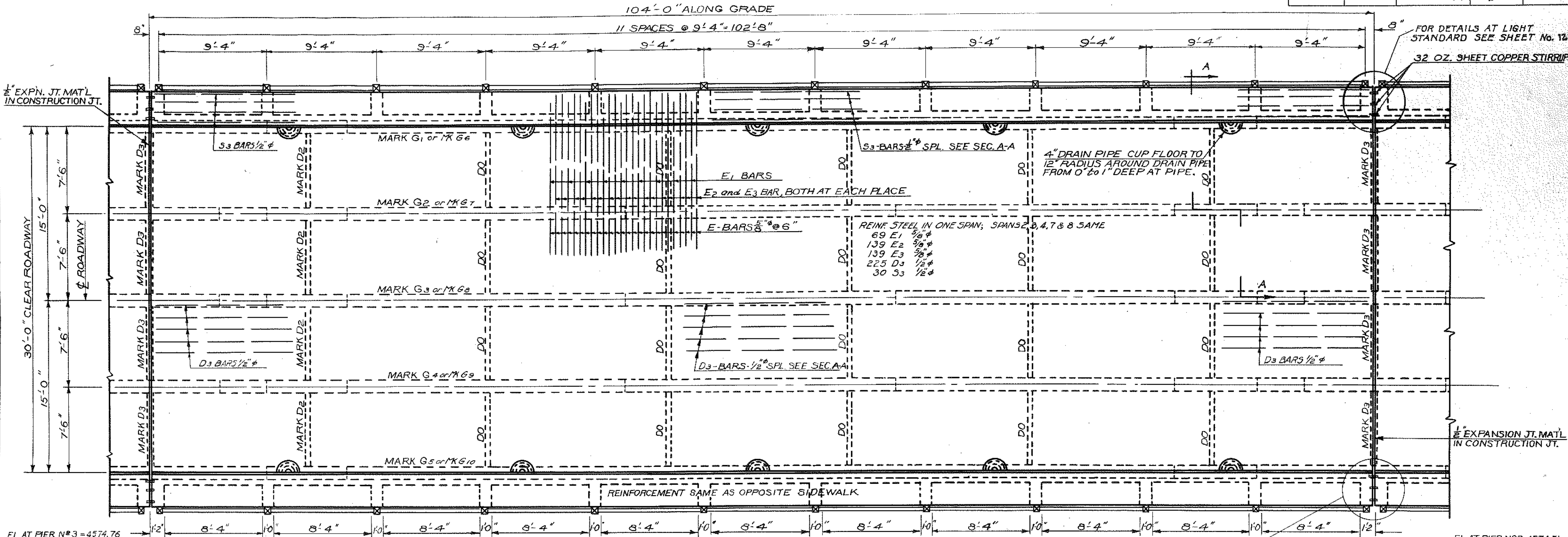
Designed by A.O.N.
Made by G.H.W.
Checked by

Approved by [signature]
Bridge Engineer
Date: Dec. 10, 1948

STRUCTURE NO. H-2-S

REVISIONS Slab thickness reduced ...

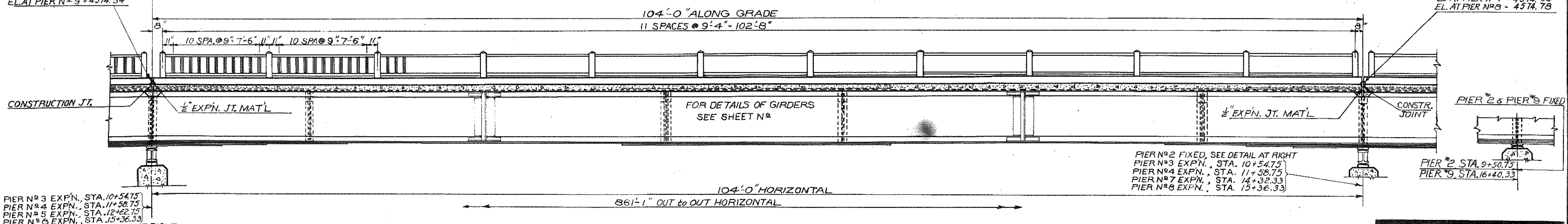
FED. ROAD DIST. NO.	STATE	PROJ. Nº	SHEET NO.	TOTAL SHEETS
3	COLO.	S-0143 (2)	9	



EL. AT PIER Nº 3 = 4574.76
EL. AT PIER Nº 4 = 4574.92
EL. AT PIER Nº 5 = 4574.99
EL. AT PIER Nº 8 = 4574.78
EL. AT PIER Nº 9 = 4574.54

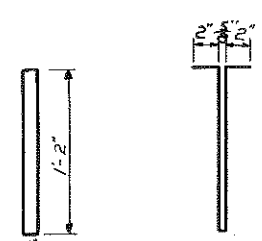
PLAN VIEW, TYPICAL FOR SPANS Nº 2, 3, 4, 7 & 8

EL. AT PIER Nº 2 = 4574.51
EL. AT PIER Nº 3 = 4574.76
EL. AT PIER Nº 4 = 4574.92
EL. AT PIER Nº 7 = 4574.93
EL. AT PIER Nº 8 = 4574.78

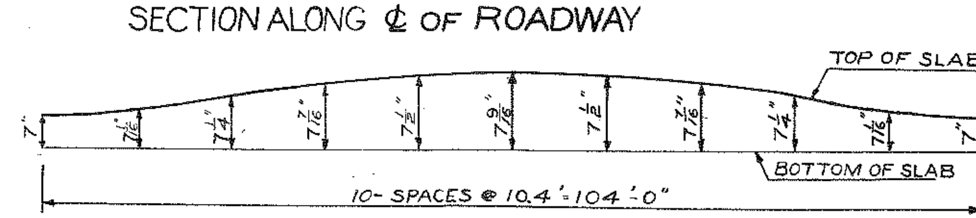


PIER Nº 3 EXP'N., STA. 10+54.75
PIER Nº 4 EXP'N., STA. 11+58.75
PIER Nº 5 EXP'N., STA. 12+62.75
PIER Nº 8 EXP'N., STA. 15+36.33
PIER Nº 9 FIXED, SEE DETAIL AT RIGHT

SECTION ALONG ℄ OF ROADWAY



DETAIL OF 32 OZ. SHEET COPPER STIRRUP



CAMBER DIAGRAM

CU. YDS. CONCRETE
(IF POURED WITHOUT LONGITUDINAL CONSTRUCTION JOINT)

78.20 CU. YD. IN 84'-0" SPAN
96.82 " " " 104'-0" SPAN

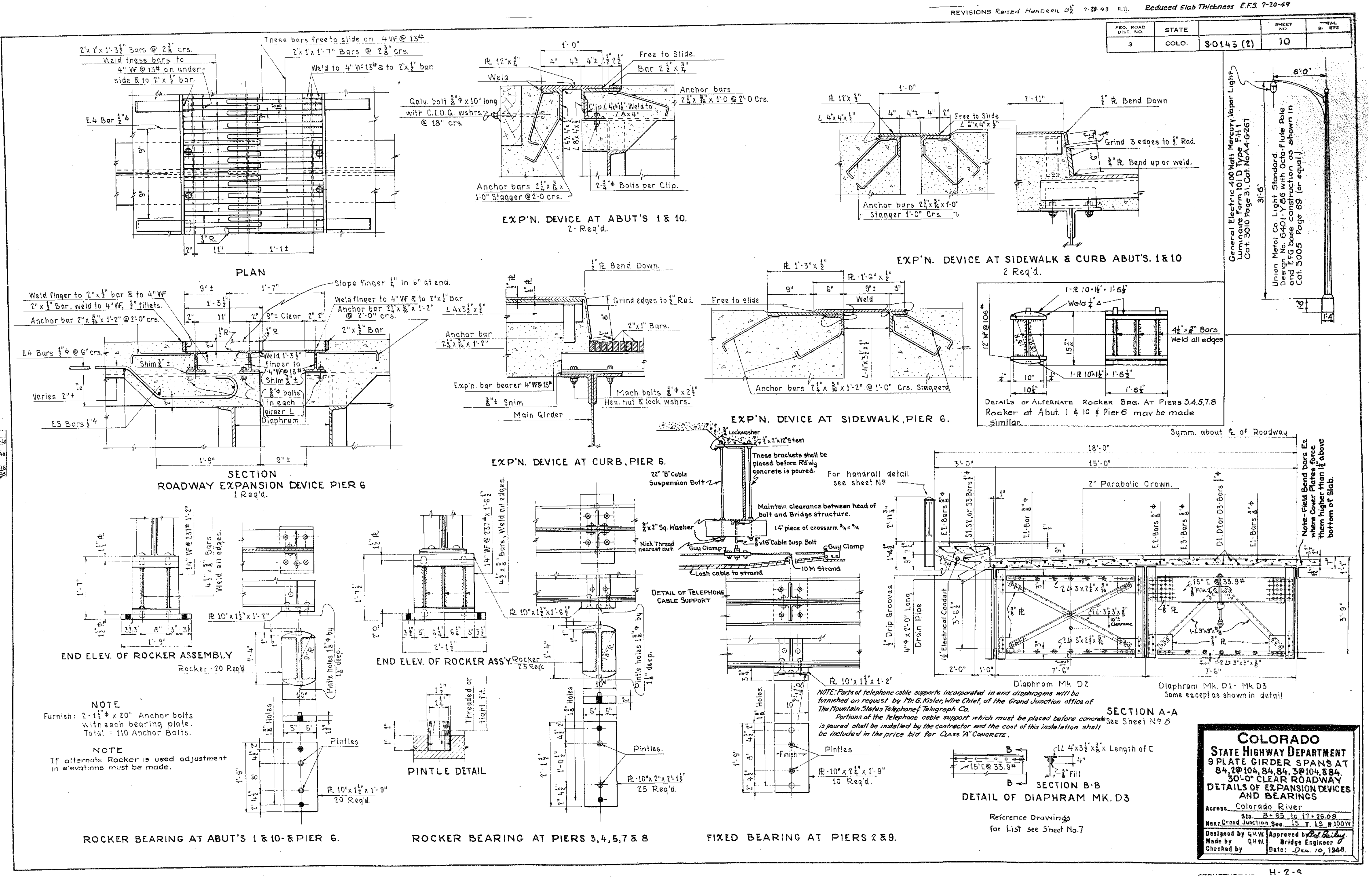
ALTERNATE POUR: A COLD JOINT OR LONGITUDINAL JOINT MAY BE PLACED ALONG THE CENTER LINE OF THE CENTER STRINGER, MAKING TWO POURS IN EACH SPAN.

REFERENCE DRAWINGS
FOR SHEET Nºs. SEE SHT. Nº 7

COLORADO
STATE HIGHWAY DEPARTMENT
9 SPANS (84', 2@104, 84 84 84, 3@104, 84)
PL GIRDER SPANS
30'-0" CLEAR ROADWAY
DETAILS OF SUPERSTRUCTURE,
104'-0" SPAN
Across COLORADO RIVER
Sta. 8+65 to 17+26.08
Near GRAND JCT. Sec. 15 T.1S S. R.100W

Designed by ADN Made by Checked by	Approved by G.S. Bailey Bridge Engineer Date: Dec. 10 1948

STRUCTURE NO. H-2-S

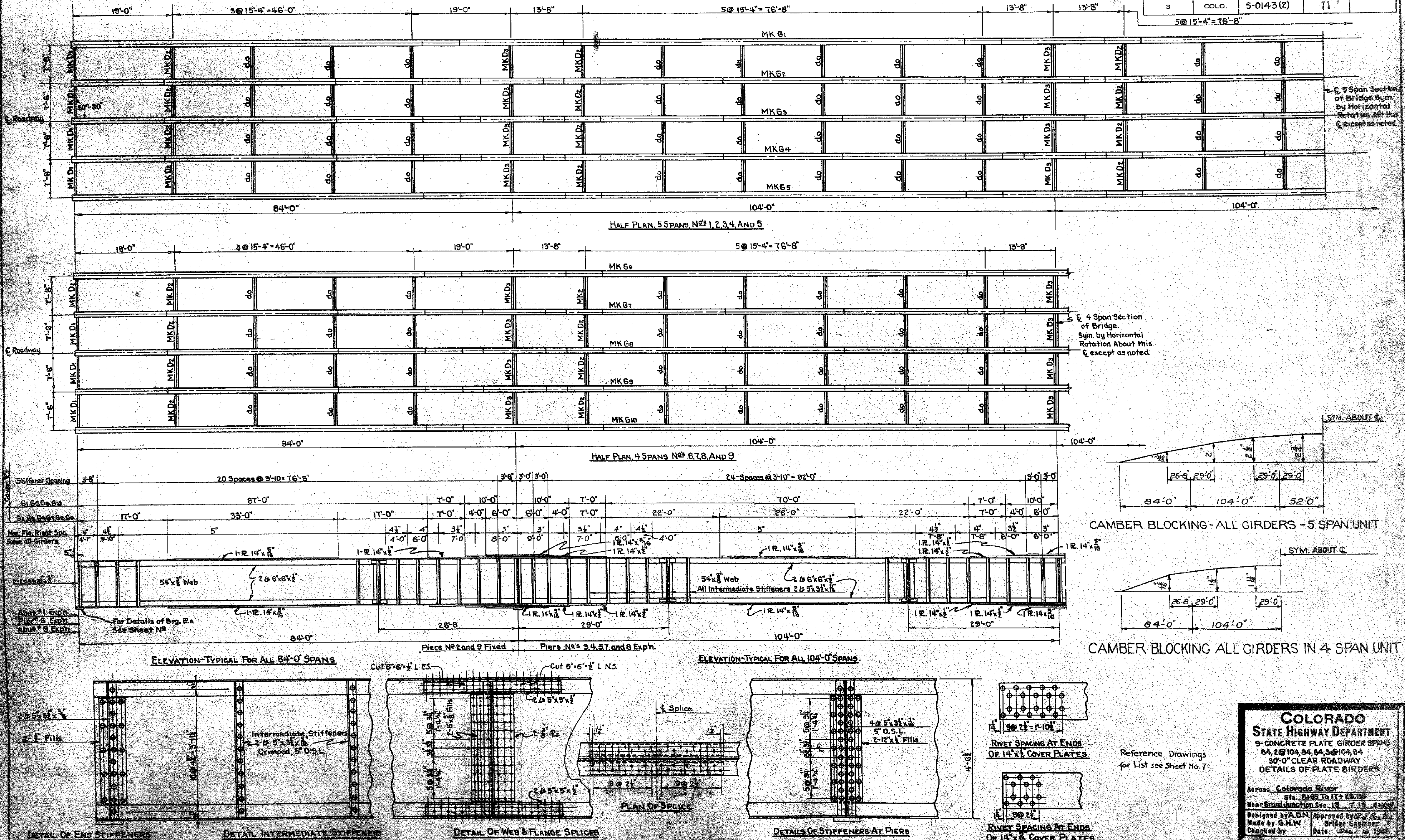


REVISIONS Raised Handrail 9½" 7-20-49 R.H. Reduced Slab Thickness E.F.S. 7-20-49
FED. ROAD DIST. NO. 3 | STATE COLO. | S-0143 (2) | SHEET NO. 10
PLAN
SECTION
ROADWAY EXPANSION DEVICE PIER 6
1 Req'd.
EXP'N. DEVICE AT ABUT'S 1 & 10.
2 Req'd.
EXP'N. DEVICE AT CURB, PIER 6.
EXP'N. DEVICE AT SIDEWALK & CURB ABUT'S. 1 & 10
2 Req'd.
EXP'N. DEVICE AT SIDEWALK, PIER 6.
General Electric 400 Watt Mercury Vapor Light Luminaire Form 101 D Type FH1 Cat. 3010 Page 31. Cat. No. A-G-267
Union Metal Co. Light Standard. Design No. 6401-Y86 with Octa-Flute Pole and EFG base construction as shown in Cat. 3005 Page 69 (or equal.)
DETAILS OF ALTERNATE ROCKER BRG. AT PIERS 3,4,5,7,8
Rocker at Abut. 1 & 10 & Pier 6 may be made similar.
END ELEV. OF ROCKER ASSEMBLY
Rocker - 20 Req'd.
END ELEV. OF ROCKER ASSY.
Rocker 25 Req'd.
NOTE
Furnish: 2-1⅛"Φ x 20" Anchor bolts with each bearing plate. Total = 110 Anchor Bolts.
NOTE
If alternate Rocker is used adjustment in elevations must be made.
PINTLE DETAIL
DETAIL OF TELEPHONE CABLE SUPPORT
NOTE: Parts of telephone cable supports incorporated in end diaphragms will be furnished on request by Mr. G. Kisler, Wire Chief, of the Grand Junction office of The Mountain States Telephone & Telegraph Co.
Portions of the telephone cable support which must be placed before concrete is poured shall be installed by the contractor and the cost of this installation shall be included in the price bid for Class "A" Concrete.
ROCKER BEARING AT ABUT'S 1 & 10 - & PIER 6.
ROCKER BEARING AT PIERS 3,4,5,7 & 8
FIXED BEARING AT PIERS 2 & 9.
Diaphram Mk D2
Diaphram Mk. D1 - Mk D3
Same except as shown in detail
SECTION A-A
See Sheet No. 8
SECTION B-B
DETAIL OF DIAPHRAM MK. D3
Reference Drawings for List see Sheet No. 7
COLORADO
STATE HIGHWAY DEPARTMENT
9 PLATE GIRDER SPANS AT 84, 2@104, 84, 84, 3@104, 84 & 84.
30'-0" CLEAR ROADWAY
DETAILS OF EXPANSION DEVICES AND BEARINGS
Across Colorado River
Sta. 8+65 to 17+26.08
Near Grand Junction Sec. 15 T. 1S R. 100W
Designed by G.H.W. Made by G.H.W. Checked by
Approved by R.J. Bailey Bridge Engineer
Date: Dec. 10, 1948
H-2-8

REVISIONS

Rev. 1-7-49 A.D.N. Flange Splice

FED. ROAD DIST. NO.	STATE	PROJ. No.	SHEET NO.	TOTAL SHEETS
3	COLO.	S-0143(2)	11	



Reference Drawings for List see Sheet No. 7

COLORADO
STATE HIGHWAY DEPARTMENT
9-CONCRETE PLATE GIRDER SPANS
84, 2@104, 84, 84, 3@104, 84
30'-0" CLEAR ROADWAY
DETAILS OF PLATE GIRDERS

Across Colorado River
Sta. 8+85 To 17+28.08
Near Grand Junction Sec. 15 T. 1S R. 100W

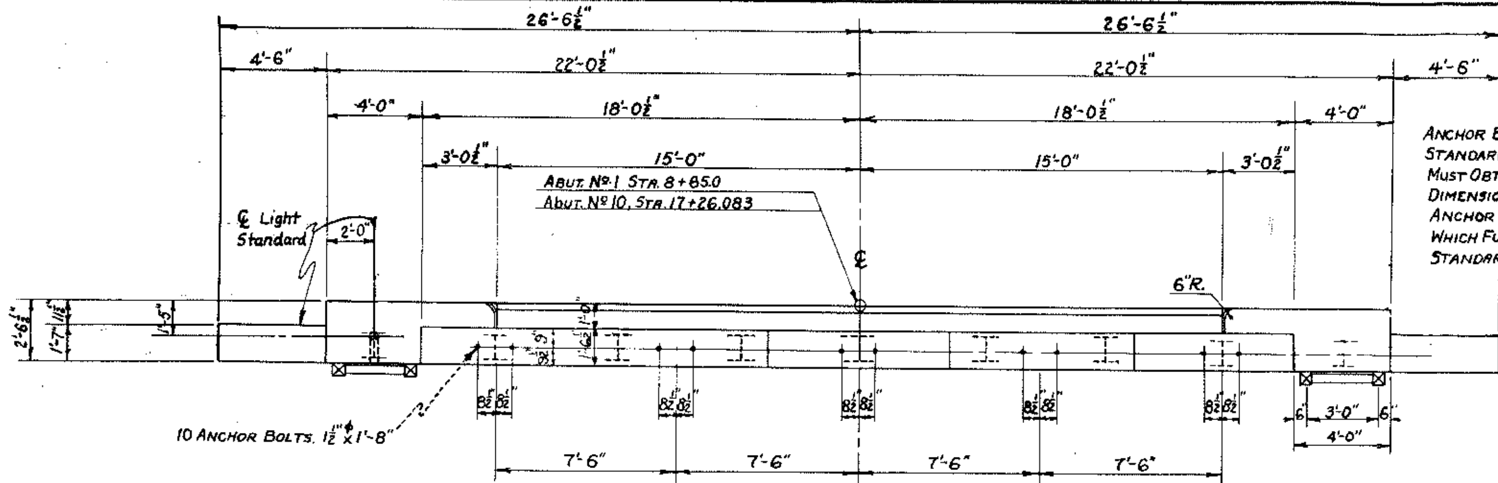
Designed by A.D.N.	Approved by
Made by G.H.W.	Bridge Engineer
Checked by	Date: Dec. 10, 19[illegible]

H-2-S

REVISIONS

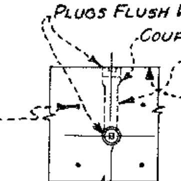
FED. ROAD DIST. NO	STATE	PROJ. Nº	SHEET No.	TOTAL SHEETS
3	COLO.	S-0143(2)	12	

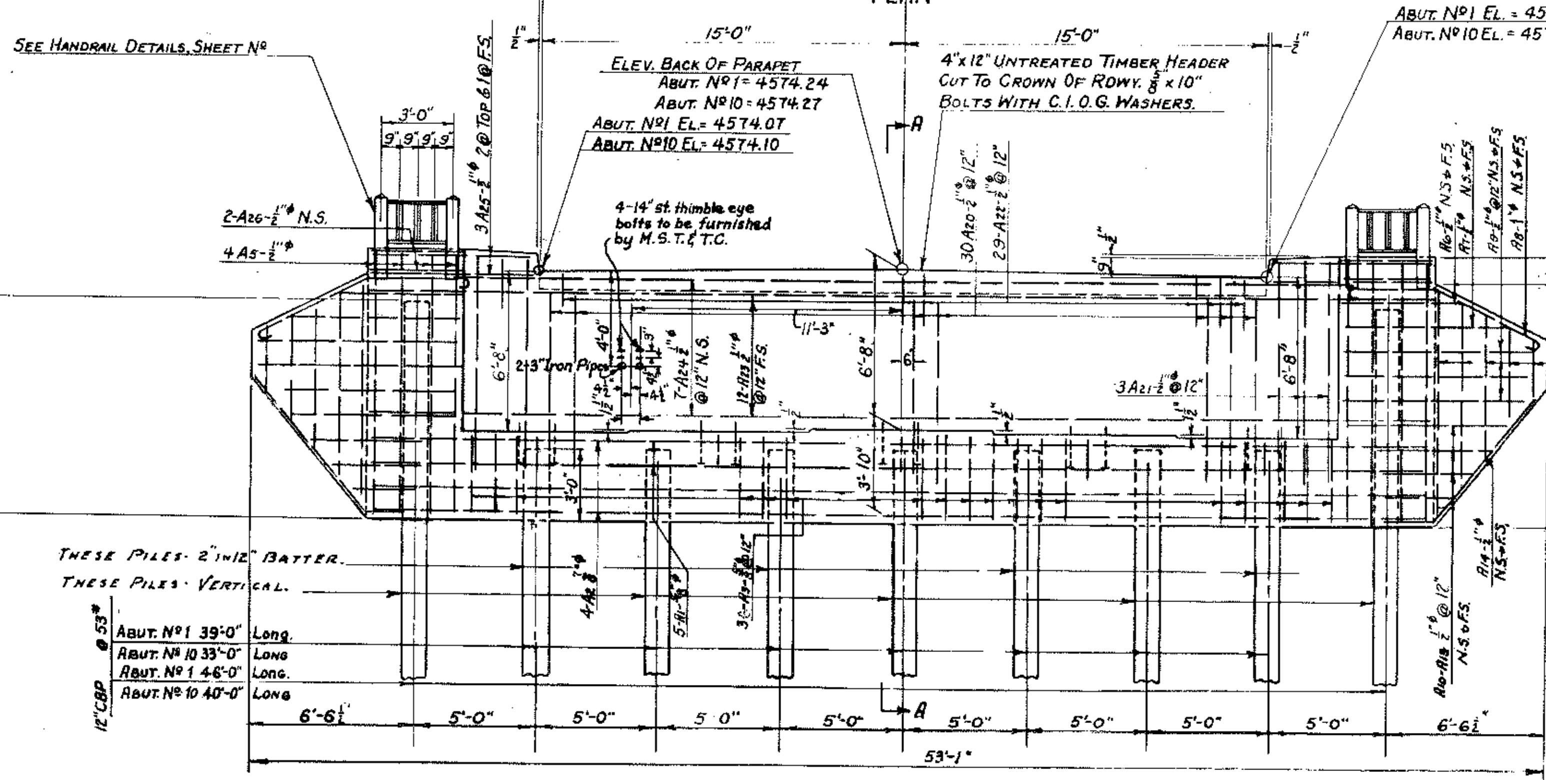
REVISED 6-13-49. J.W.B. Steel Piling
" 7-20-49 E.F.S. Raised Seat
" 10-24-49 (L.W.F. Moved Light Std. out 8"



PLAN

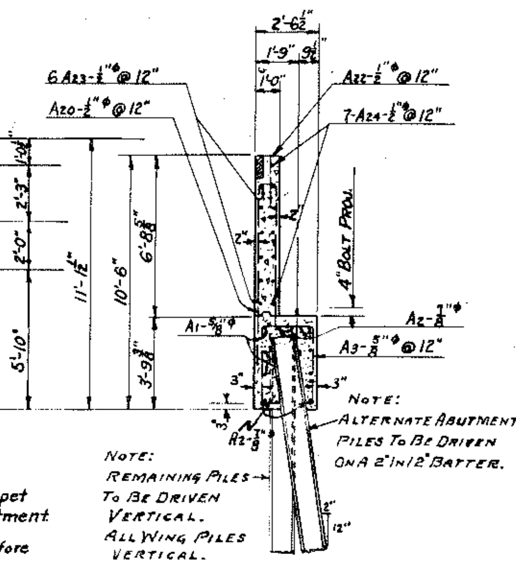
ANCHOR BOLTS FOR LIGHTING STANDARD. THE CONTRACTOR MUST OBTAIN THE SIZE OF, AND DIMENSIONS FOR SETTING THESE ANCHOR BOLTS FROM THE COMPANY WHICH FURNISHES THE LIGHT STANDARDS.





Note~ Structural Steel shall be in place before parapet is poured.

Note~ Make a construction joint without key between parapet wall and sidewalls of abutment.
Place and compact fill before driving Piles.



SECTION "A-A".

Note~ Position of pipes and bolts for telephone cable as shown for Abut. No. 1 opposite hand for Abut. No. 10

ELEVATION

MAX. PILE LOAD = 40.9 TONS

DETAILS OF ABUTMENTS Nº 1 AND Nº 10

BAR LIST~ SUPERSTRUCTURE						
MARK	SIZE	No. REQ'D	LENGTH	TYPE	DIM. l	TOTAL LENGTH
E1	⅝"φ	568	34'-11"	I		19833
E2	⅝"φ	1145	37'-5"	II		42843
E3	⅝"φ	1145	34'-3"	III	32'-7	39217
E4	½"φ	52	4'-6½"	IV		237
E5	½"φ	12	6'-6"	Str.		78
D1	½"φ	675	29'-5"	Str.		19857
D2	½"φ	225	29'-1"	Str.		6544
D3	½"φ	1125	36'-0"	Str.		40500
S1	½"φ	60	29'-5"	Str.		1765
S2	½"φ	60	29'-6"	Str.		1770
S3	½"φ	150	36'-0"	Str.		5400
S4	⅝"φ	12	6'-0"	VII		72
S5	½"φ	12	1'-4"	Str.		16

BAR SUMMARY FOR SUPERSTRUCTURE
76,167 Lin. Ft. ½"φ @ .668#/Lin. Ft. = 50880
101,965 " " ⅝"φ @ 1.043#/ " " = 106350
± 1% Overrun = 1570
Total = 158800#

BAR SUMMARY~ ABUT. Nº 1 - ABUT. Nº 10 SAME AS 1
43 Lin. Ft 1"φ @ 2.67#/Lin. Ft. = 115
312 " " ⅞"φ @ 2.044#/ " " = 638
608 " " ⅝"φ @ 1.043 " " = 634
1783 " " ½"φ @ .668 " " = 1191
± 1% = 22
Total 2600

BAR LISTS~ ~ ABUTMENTS Nº 1 AND Nº 10							
MARK	SIZE	Nº REQ'D	LENGTH	TYPE	DIMENSION l	DIMENSION m	TOTAL LENGTH
A1	⅝"φ	5	43'-8"	Str.			218
A2	⅞"φ	8	39'-0"	Str.			312
A3	⅝"φ	36	10'-10"	V	3'-1"	2'-0"	390
~~A4~~	~~⅝"φ~~	~~5~~	~~7'-2"~~	~~V~~	~~1'-3"~~	~~2'-0"~~	~~36~~
A5	½"φ	8	25'-10"	V	10'-7"	2'-0"	207
A6	½"φ	4	5'-0"	Str.			20
A7	½"φ	4	6'-8"	Str.			27
A8	1"φ	4	10'-9"	IX	Dim. r 4"	Dim. t 3½"	43
A9	½"φ	12	7'-8"	Str.			90
A10 to A13	½"φ	4 ea.	5'-0" by 9" to 2'-9"	Str.			62
A14	½"φ	4	9'-0"	Str. Field Bend			36
A15 to A19	½"φ	4 ea.	2'-6" by 1'-9" to 9'-6"	Str.			120
A20	½"φ	30	16'-4"	VI	7'-10	0'-8"	490
A21	½"φ	6	19'-6"	VI	9'-5	0'-8"	117
A22	½"φ	29	2'-0"	Str.			58
A23	½"φ	6	40'-6"	Str.			243
A24	½"φ	7	37'-0"	Str.			259
A25	½"φ	6	6'-8"	Str.			40
A26	½"φ	4	3'-8"	Str.			15

Above Lists for One Abutment

BAR LISTS FOR PIERS 2, 3, 4, 5, 6, 7, 8, AND 9

MARK	SIZE	LENGTH	TYPE	DIMENSIONS l	m	n	r	t	NUMBER REQ'D PIER 2	PIER 3	PIER 4	PIER 5	PIER 6	PIER 7	PIER 8	PIER 9
W1	⅞"φ	11'-1"	III	8'-9"			3½	3"	78							
W2	½"φ	38'-6"	Str.						10	9	9	9	9	9	9	9
W3	¾"φ	8'-11"	VII	7'-11"			3"	2½"	70							
W4	⅝"φ	5'-6"	VII	4'-8"			2½	2"	70							
W5	⅝"φ	24'-2"	Str.						64							64
W6	⅝"φ	34'-10	Str.						6							
W7	⅝"φ	38'-2	Str.						70							
W8	½"φ	33'-0	Str.						78	72	64	64	70	64	64	70
W9	½"φ	7'-1"	VIII	2'-6	1'-0½	1'-6			2	2	2	2		2	2	2
W10	½"φ	7'-1¾	VIII	2'-6	1'-0⅛	1'-6½			2	2	2	2		2	2	2
W11 To W40	½"φ	7'-2½" by ¾ to 9'-0¼	VIII	2'-6	1'-1¼ by ⅜ to 2'-0⅛	1'-7" by ½ to 2'-9½			2 EA.	2 EA.	2 EA.	2 EA.	2 EA.	2 EA.	2 EA.	2 EA.
W41	½"φ	9'-1"	VIII	2'-6"	2'-0½	2'-10			2	2						2
W42	½"φ	9'-1¾"	VIII	2'-6"	2'-0⅞	2'-10½			2	2						2
W43	½"φ	9'-2½"	VIII	2'-6"	2'-1¼"	2'-11"			2	2						2
W44	½"φ	9'-3¼"	VIII	2'-6	2'-1⅝	2'-11½			2	2						
W45	½"φ	9'-4"	VIII	2'-6"	2'-2"	3'-0"			2							
W46	½"φ	9'-4¾"	VIII	2'-6"	2'-2⅜	3'-0½			2							
W47	½"φ	9'-5½"	VIII	2'-6	2'-2¾	3'-1"			2							
W48	¾"φ	10'-4"	III	8'-4"			3"	2½"		67						
W49	⅝"φ	5'-2"	VII	4'-4"			2½"	2"		74	74	74	74	74	74	
W50	⅝"φ	35'-8"	Str.							74						
W51	⅝"φ	9'-1"	III	7'-5"			2½"	2"			78	78	78	78	78	
W52	⅝"φ	31'-8	Str.								74	74	74	74	74	
W53	½"φ	9'-2"	V	2'-8	1'-7"								34			
W54	¾"φ	10'-1"	III	8'-1"			3"	2½"								85
W55	⅝"φ	7'-4"	VII	6'-6"			2½"	2"								70
W58	½"φ	4'-5"	VII	3'-9"			2"	2"								70
W57	⅝"φ	32'-6"	Str.													8
W58	½"φ	34'-8"	Str.													70
W59	½"φ	8'-8½"	VIII	2'-6"	1'-10¼"	2'-7"							4			

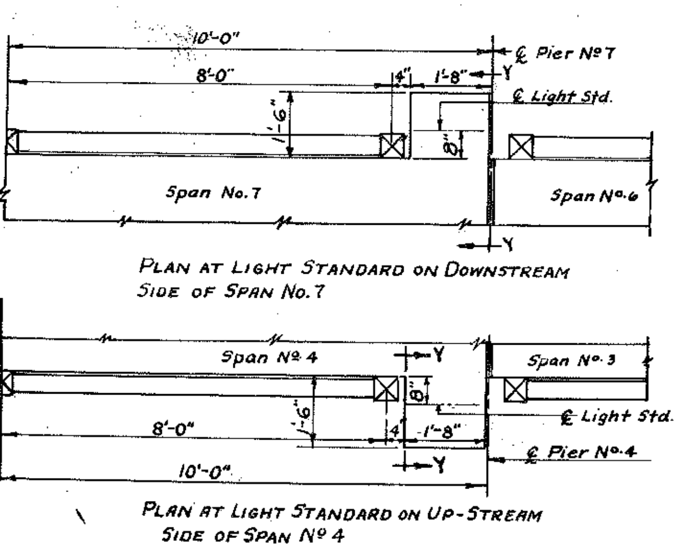
BAR SUMMARY - PIER Nº 2
3605 Lin. Ft. ½"φ @ 0.668# Per Lin. Ft. = 2408
4813 " " ⅝"φ @ 1.043# " " " = 5020
625 " " ¾"φ @ 1.502# " " " = 939
865 " " ⅞"φ @ 2.044# " " " = 1768
± 1% Overrun = 105
Total = 10,240#

BAR SUMMARY ~ PIER Nº 3
3312 Lin. Ft. ½"φ @ 0.668# Per Lin. Ft. = 2212
3022 " " ⅝"φ @ 1.043# " " " = 3152
693 " " ¾"φ @ 1.502# " " " = 1041
± 1% Overrun = 65
Total = 6470#

BAR SUMMARY - PIER Nº 4 - PIERS 5, 7, 8 SAME
2974 Lin. Ft. ½"φ @ 0.668# Per Lin. Ft. = 1987
3435 " " ⅝"φ @ 1.043# " " " = 3583
± 1% Overrun = 60
Total = 5630#

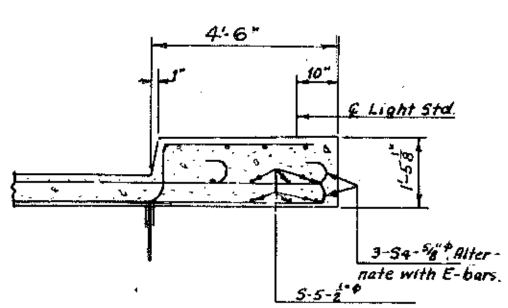
BAR SUMMARY ~ PIER Nº 6
3490 Lin. Ft. ½"φ @ 0.668# Per Lin. Ft. = 2331
3435 " " ⅝"φ @ 1.043# " " " = 3583
± 1% Overrun = 56
Total = 5970

BAR SUMMARY ~ PIER Nº 9
5963 Lin. Ft. ½"φ @ 0.668# Per Lin. Ft. = 3983
2255 " " ⅝"φ @ 1.043# " " " = 2352
857 " " ¾"φ @ 1.502# " " " = 1287
± 1% Overrun = 78
Total = 7700



PLAN AT LIGHT STANDARD ON DOWNSTREAM SIDE OF SPAN No. 7

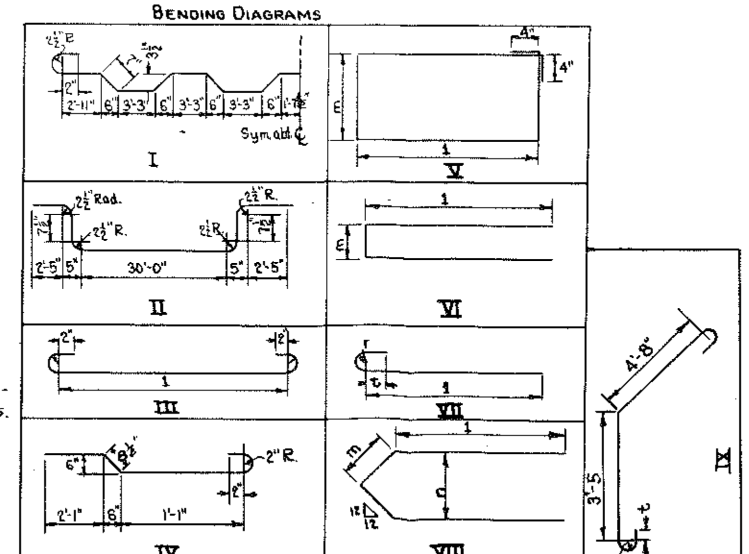
PLAN AT LIGHT STANDARD ON UP-STREAM SIDE OF SPAN Nº 4



SECTION Y-Y

Note~ Attention is called to note concerning Light Standard Anchor Bolts.

BENDING DIAGRAMS



Reference Drawings for List see Sheet No. 7

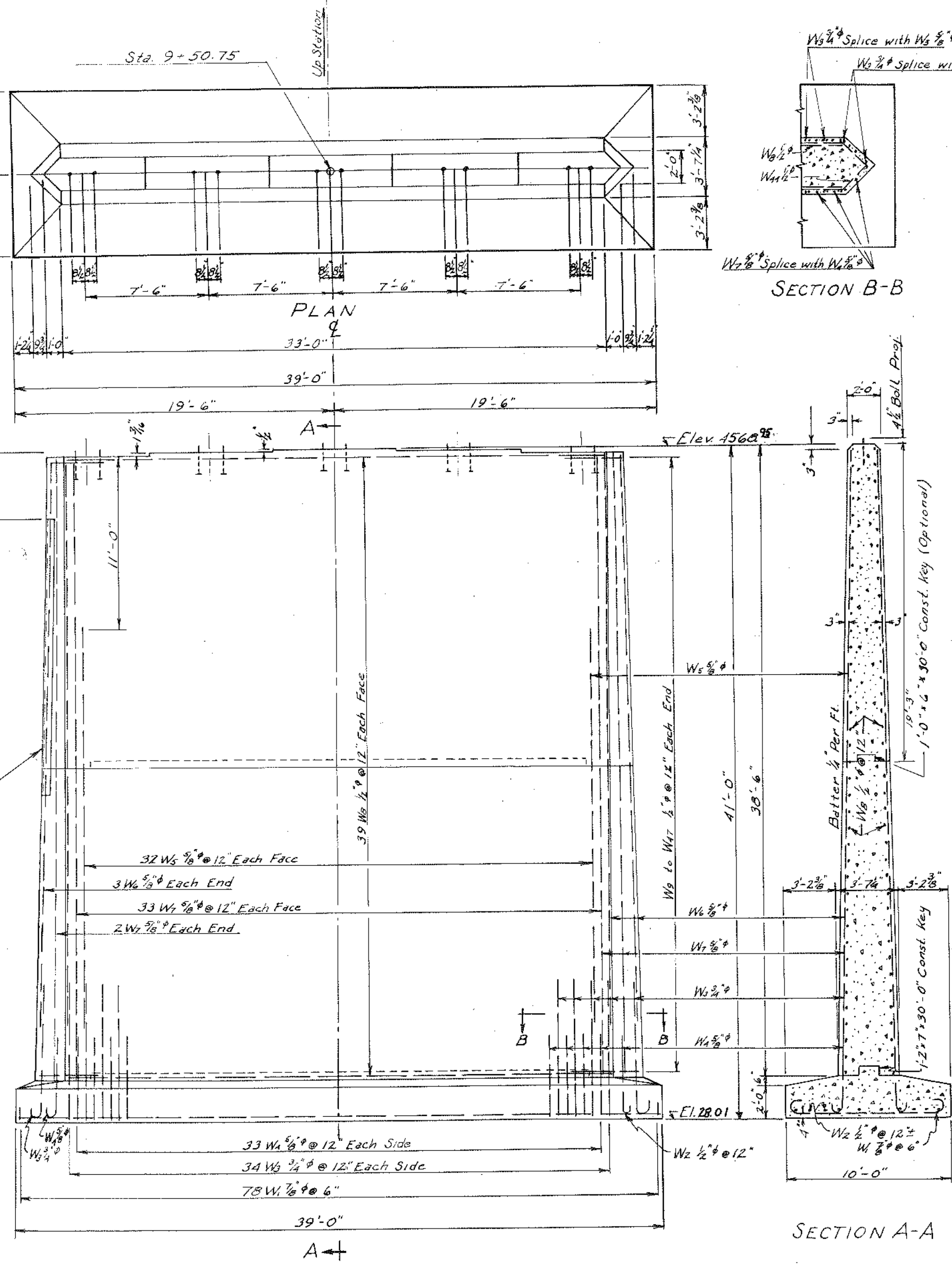
COLORADO
STATE HIGHWAY DEPARTMENT
9-SPANS (84, 2@104, 84-84, 3@104, 84)
PLATE GIRDER SPANS
30'-0" CLEAR ROADWAY
DETAILS OF ABUTMENTS Nº 1 & Nº 10

Across COLORADO RIVER
Sta. 8+65 To 17+26.08
Near GRAND JUNCTION Sec. 15 T. 1 S R. 100W

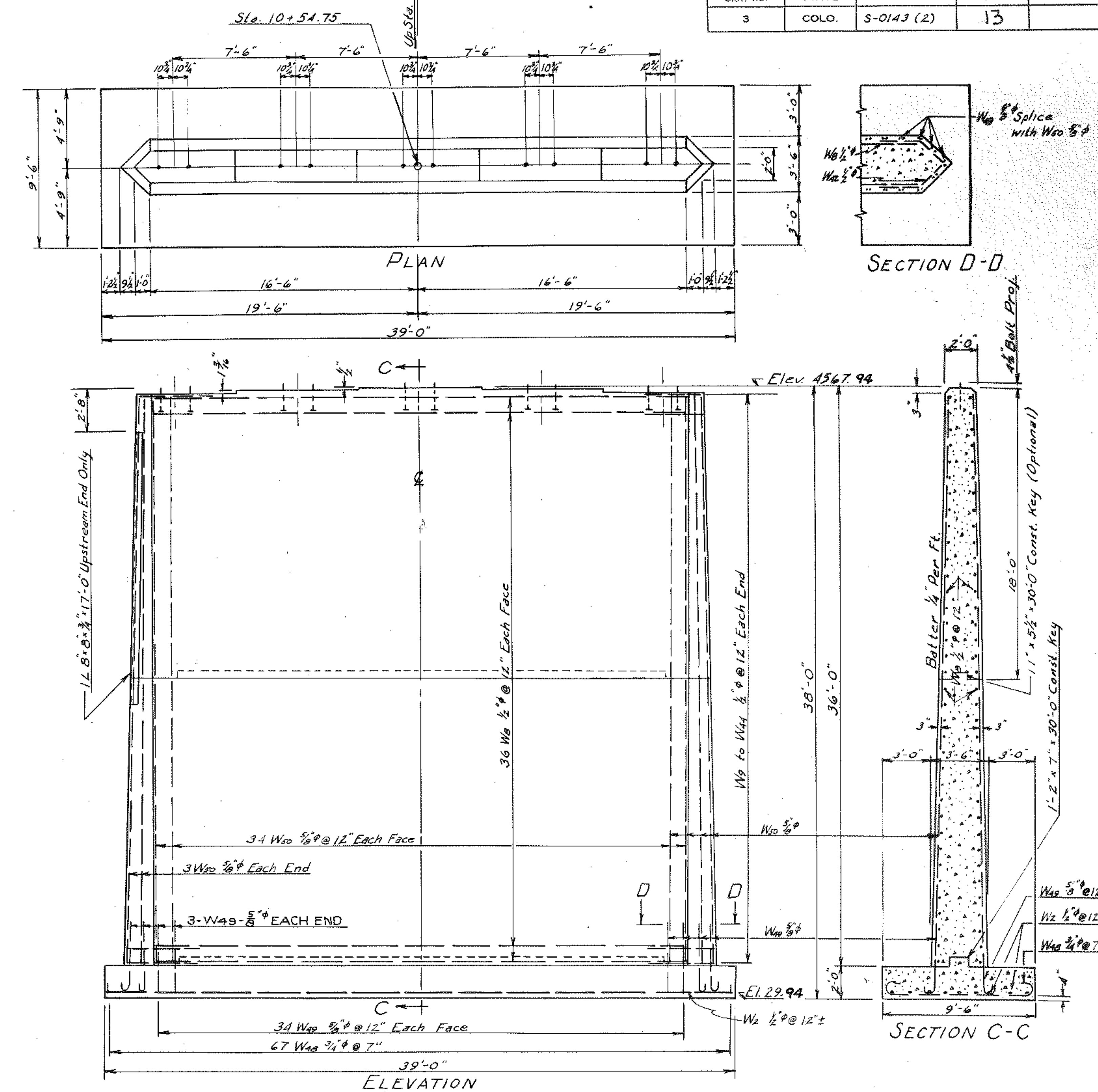
Designed by A.D.N.	Approved by R. J. Bailey
Made by G.H.W.	Bridge Engineer
Checked by	Date: Dec. 10, 1948.

STRUCTURE NO. H-2-5

FED. ROAD DIST. NO.	STATE		SHEET NO.	TOTAL SHEETS
3	COLO.	S-0143 (2)	13	



DETAILS PIER No 2
Max. Soil Pressure = 2.8 Tons / Sq. Ft.



DETAILS PIER No 3
Max. Soil Pressure = 2.0 Tons / Sq. Ft.

Cu. Yds. Concrete

	Pier 2	Pier 3
Wall	34	27.5
Footing	138	126.5
Total	172	154

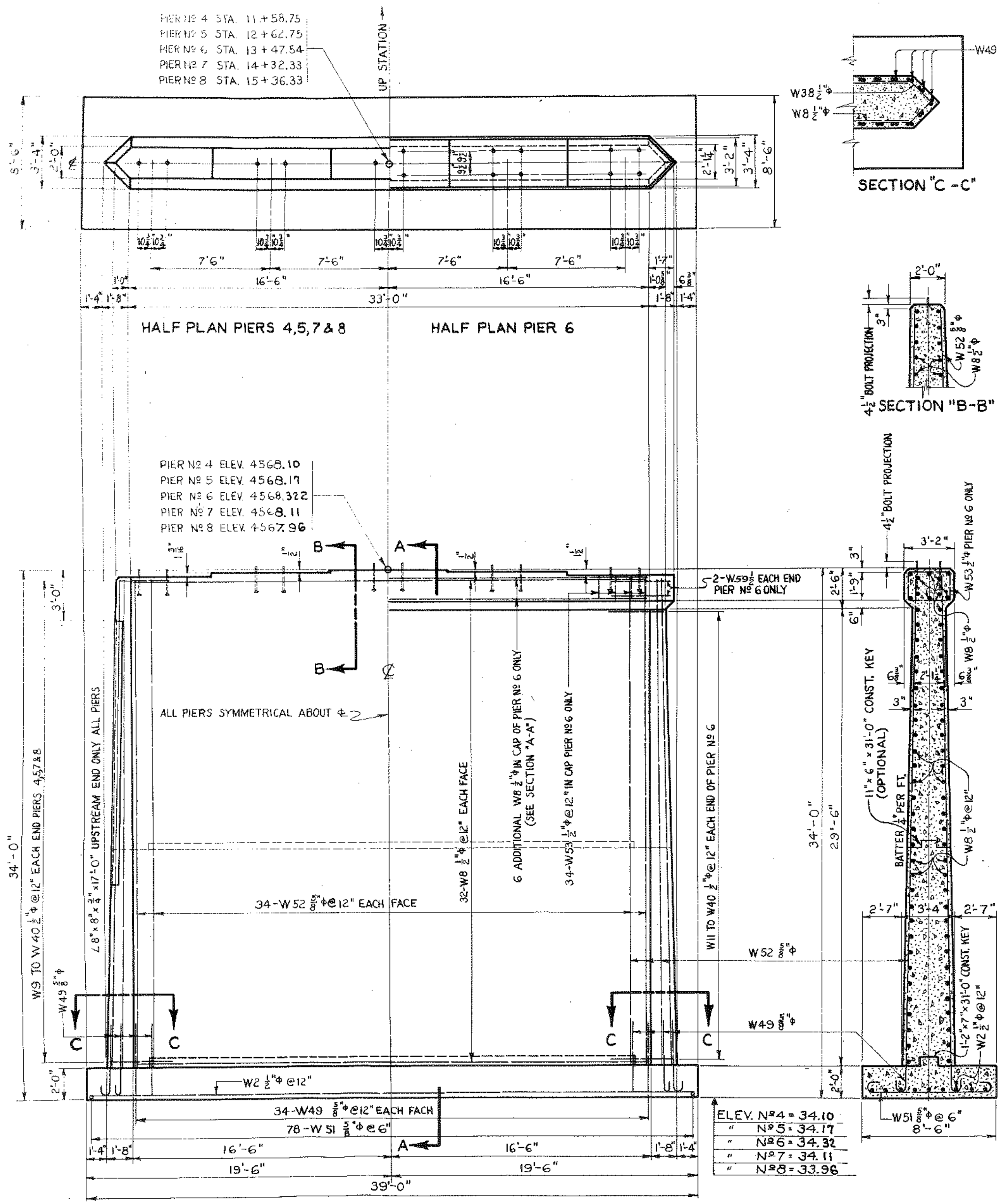
Reference Drawings
See Sheet No. 7 for detail list

REFERENCE DRAWINGS:
For List See Sheet No 7

STRUCTURE No H-2-S

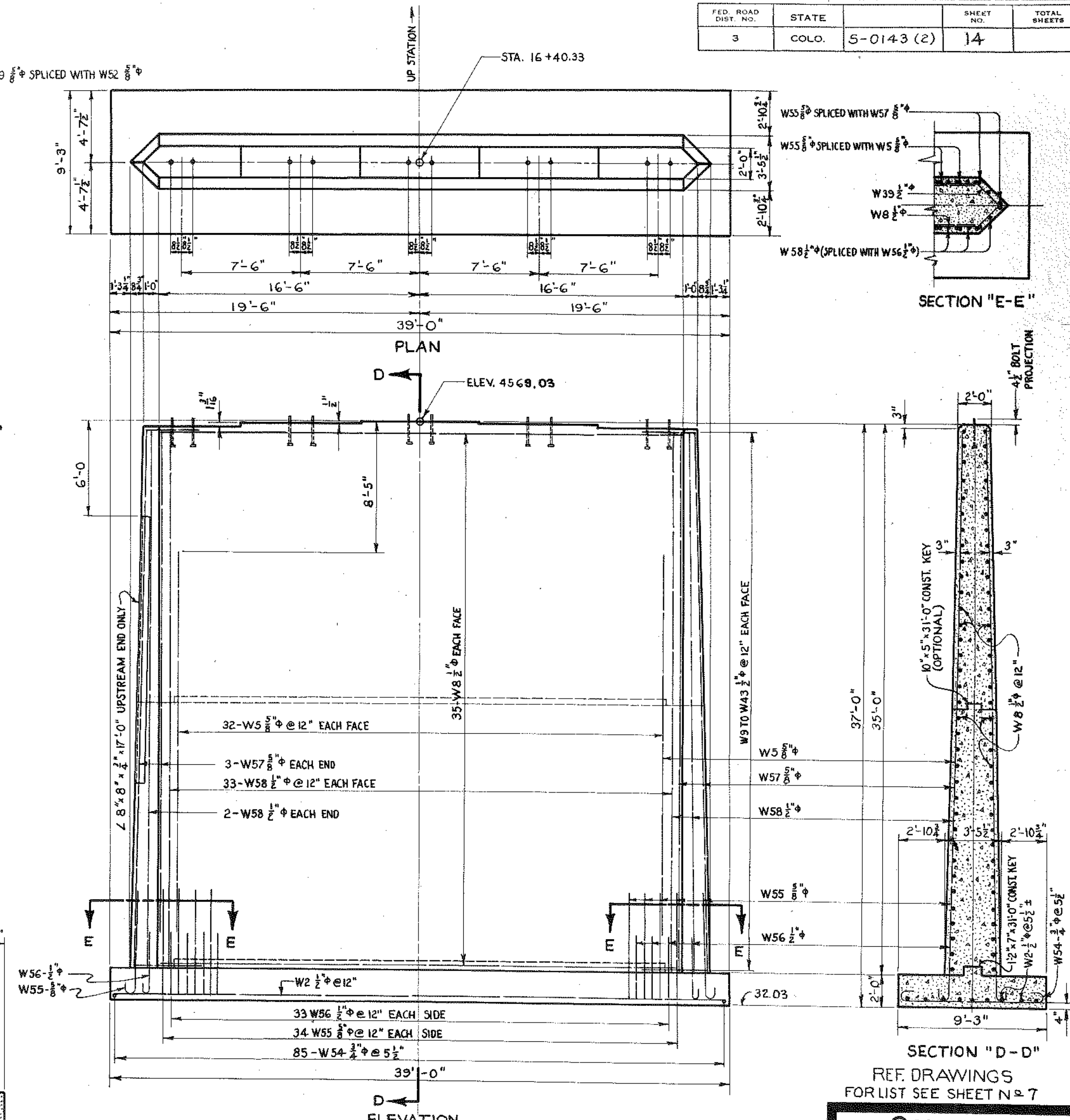
COLORADO
STATE HIGHWAY DEPARTMENT
9 Spans (84, 2@104, 84-84, 3@104, 84)
Pl. Girder Spans
30'-0" Clear Roadway
DETAILS PIERS No 2 & No 3
Across Cole River
Sta. 8+65 to 17+26.08
Near Grand Junction Sec. 15 T. 1S R. 100 W

Designed by ADN
Made by GHW
Checked by
Approved by C. S. Bailey
Bridge Engineer
Date: Dec. 10, 1948.



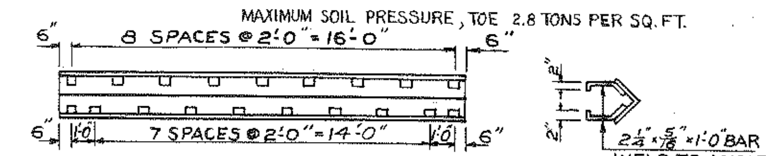
DETAILS OF PIERS 4, 5, 6, 7 & 8

MAX. SOIL PRESSURE = 2.1 TONS PER SQ.FT.



DETAILS OF PIER Nº 9

MAXIMUM SOIL PRESSURE, TOE 2.8 TONS PER SQ. FT.



DETAIL OF 8" x 8" x ¾" x 17'-0" ANGLE
8 REQ'D - ONE EACH PIER

CONCRETE POURS						
	PIER					
	Nº 4	Nº 5	Nº 6	Nº 7	Nº 8	Nº 9
WALL	108	108	111	108	108	121
FOOTING	25	25	25	25	25	27
TOTAL	133	133	136	133	133	148

STRUCTURE Nº H-2-S

REF. DRAWINGS
FOR LIST SEE SHEET Nº 7

COLORADO
STATE HIGHWAY DEPARTMENT

9 SPANS (84, 2 @ 104, 84-84, 3 @ 104, 84)
R. GIRDER SPANS
30'-0" CLEAR ROADWAY
DETAILS OF PIER 4, 5, 6, 7, 8 & 9

Across COLORADO RIVER
Sta. 8+65 to 17+26.08
Near GRAND JUNCTION Sec. 15 T. 1 S R. 100W

Designed by A.D.N.
Made by G.H.W.
Checked by

Approved by P. L. Bailey
Bridge Engineer
Date: Dec. 10, 1948.

COLORADO DEPARTMENT OF TRANSPORTATION

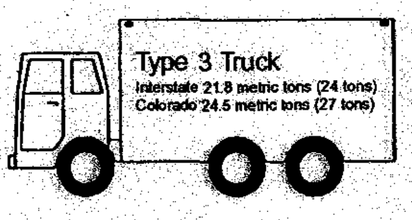
LOAD FACTOR RATING SUMMARY

Structure #	H-04-G
State highway #	330
Batch I.D.	BID# 1144
Structure type	CIC
Parallel structure #	NONE

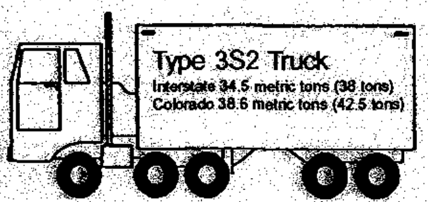
Rated using
Asphalt thickness: 216 mm (8.5 in.)
☒ Colorado legal loads
☐ Interstate legal loads

Metric tons (Tons)

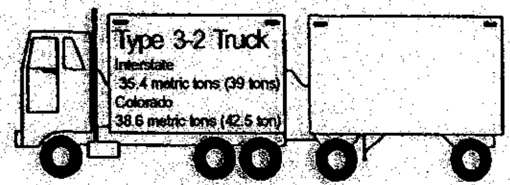
Structural member	DECK SLAB **	INTERIOR GIRDER GIRDERS C THRU E	INTERIOR GIRDER GIRDER B	EXTERIOR GIRDER GIRDER A
Inventory	28 (31)	27 (30)	25 (27)	126 (139)
Operating	47 (52)	45 (50)	42 (46)	210 (232)
Type 3 truck	( )	( )	( )	( )
Type 3S2 truck	( )	( )	( )	( )
Type 3-2 truck	( )	( )	( )	( )
Permit truck	( )	107 (118)	103 (113)	386 (425)



_______ (_______)
Metric tons Tons



_______ (_______)
Metric tons Tons



_______ (_______)
Metric tons Tons

Comments

Modified Tandem: 55 (61) 62 (69) 201 (221)
**Assumed Slab reinforcing
Control Member: Interior Girder B; Rated for 8.5" HBP
Load Capacity: 46 Tons
Girder: Interior Girder Rated for 8.5" HBP

Color Code: WHITE

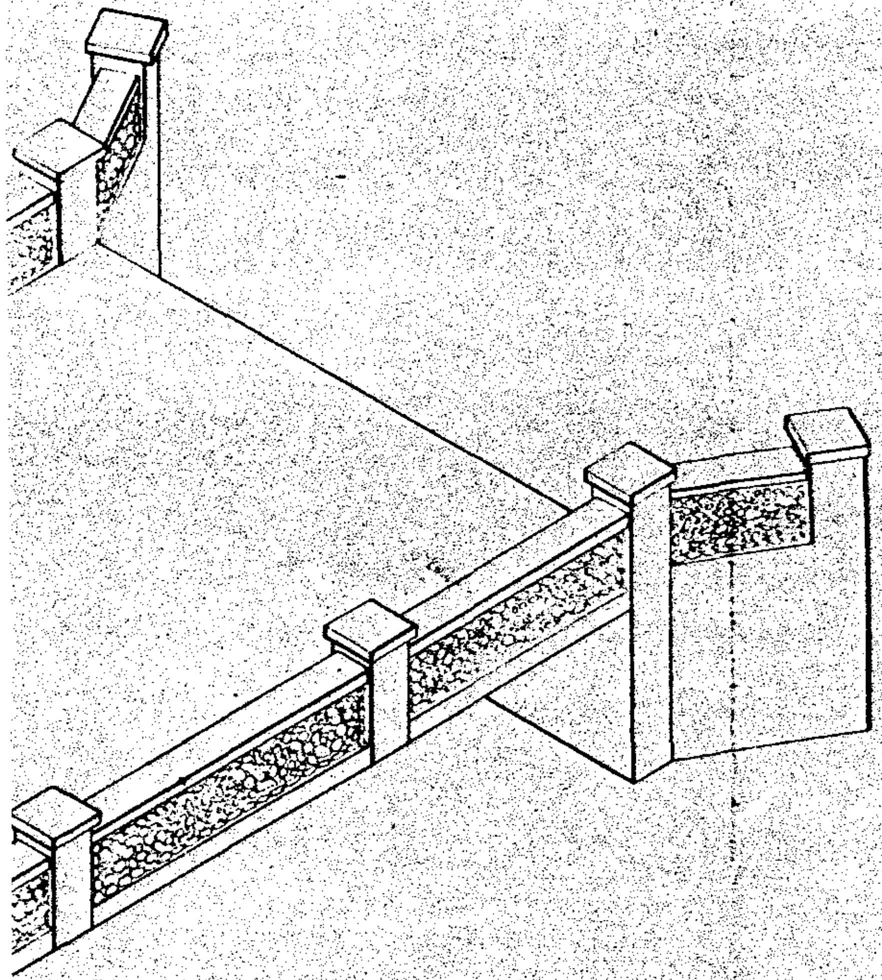
Project No: C-08-330-530

Rated by	Date	Checked by	Date
Andy Pott	11/10/03	ALI HARAJLI, PE I	11/10/03

Previous editions are obsolete and may not be used

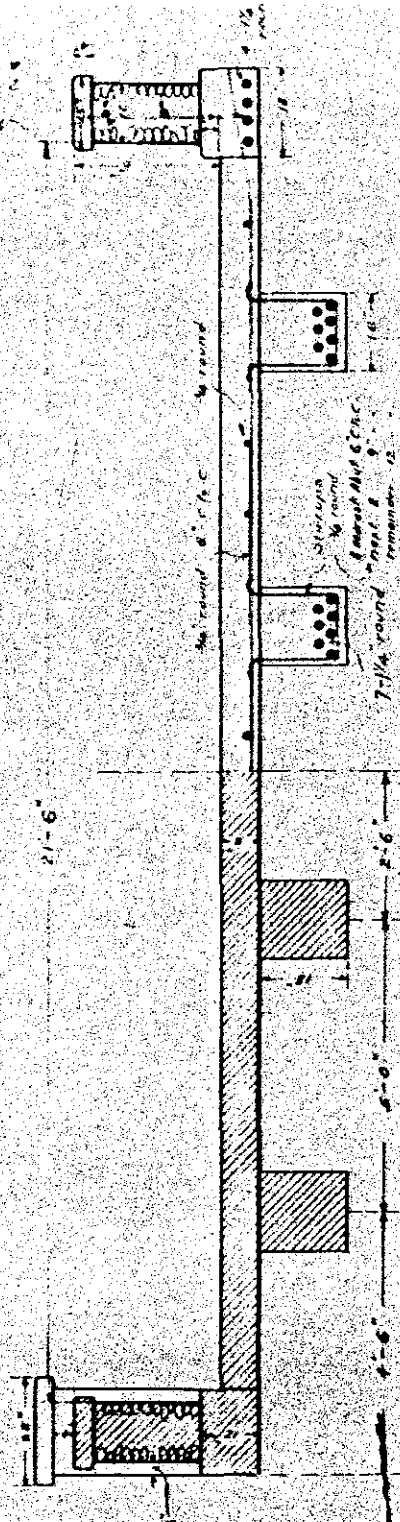
CDOT Form #1187a 1/95

PLAN OF
PROPOSED CONCRETE BRIDGE
LOCATED AT
BIG CREEK – MILE POST 41.9
STATE ROAD 65
MESA COUNTY, COLO. Mar. 12, 1918.
E.R. Romberg
Gen. Road Supervisor

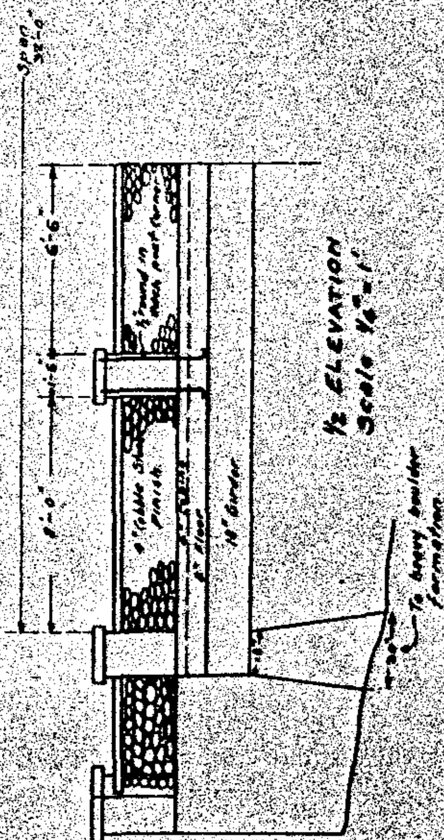


COST ESTIMATE

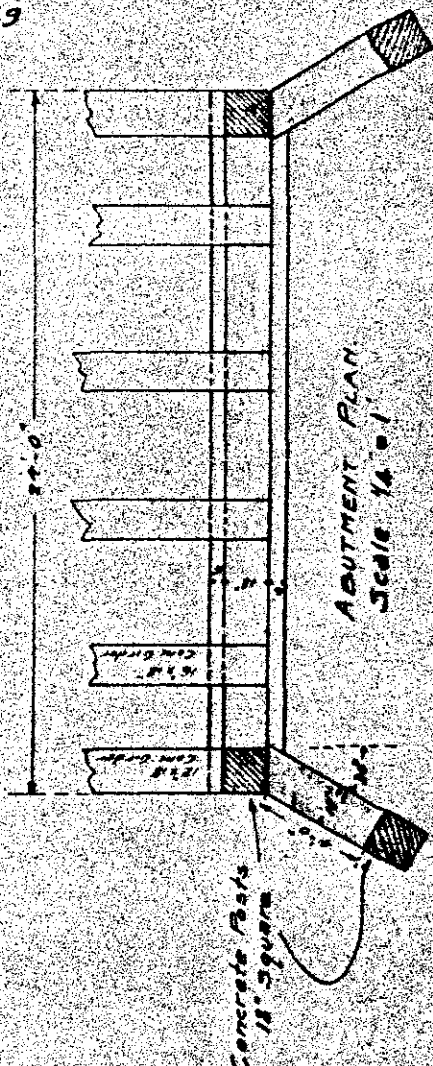
	Excavation	$50.00
(14 per yd inc. forms)	67 Cu. yds. 1:4 Concrete	938.00
8 cts. per lb	9000# Reinforcement	720.00
	Total	1708.00



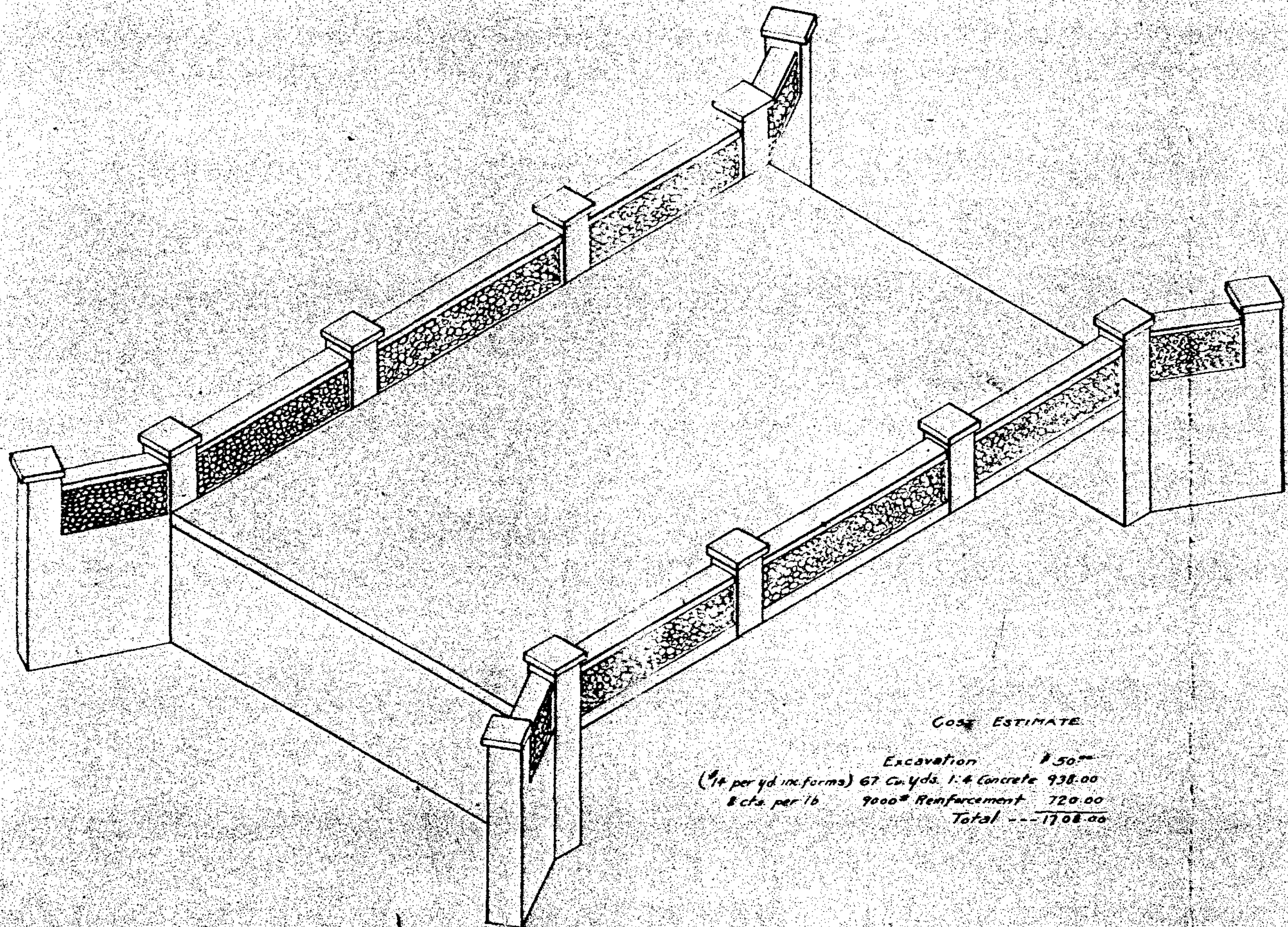
SECTION.
Scale 1/2"=1'



1/2 ELEVATION
Scale 1/4"=1'

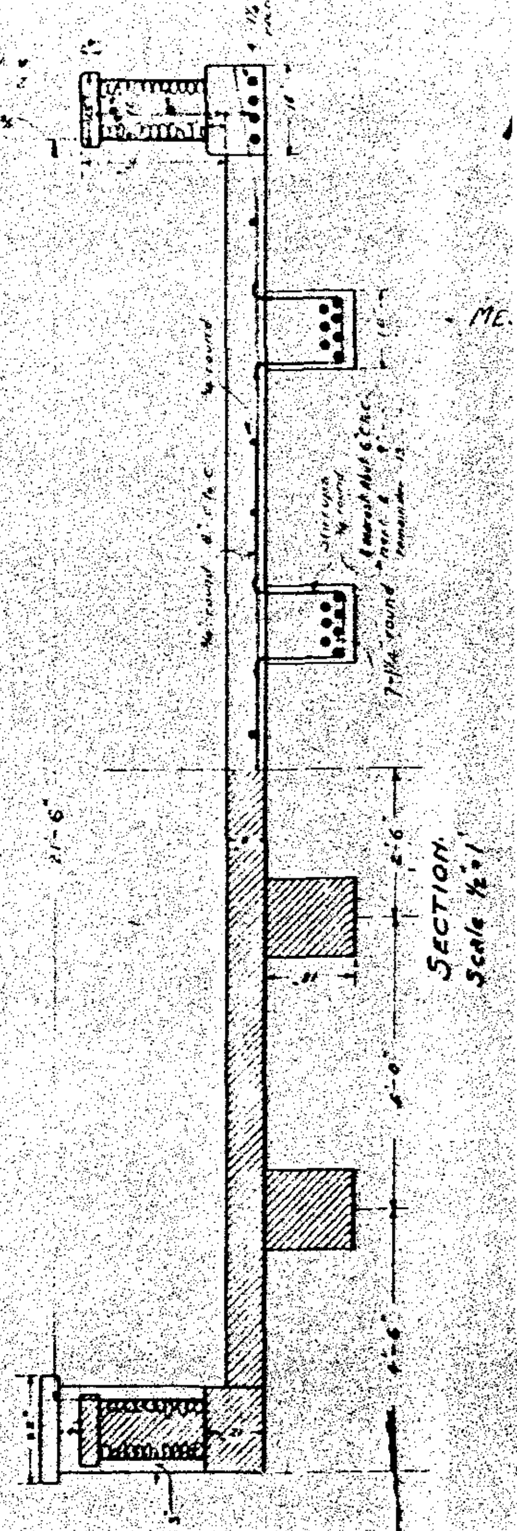


ABUTMENT PLAN.
Scale 1/4"=1'

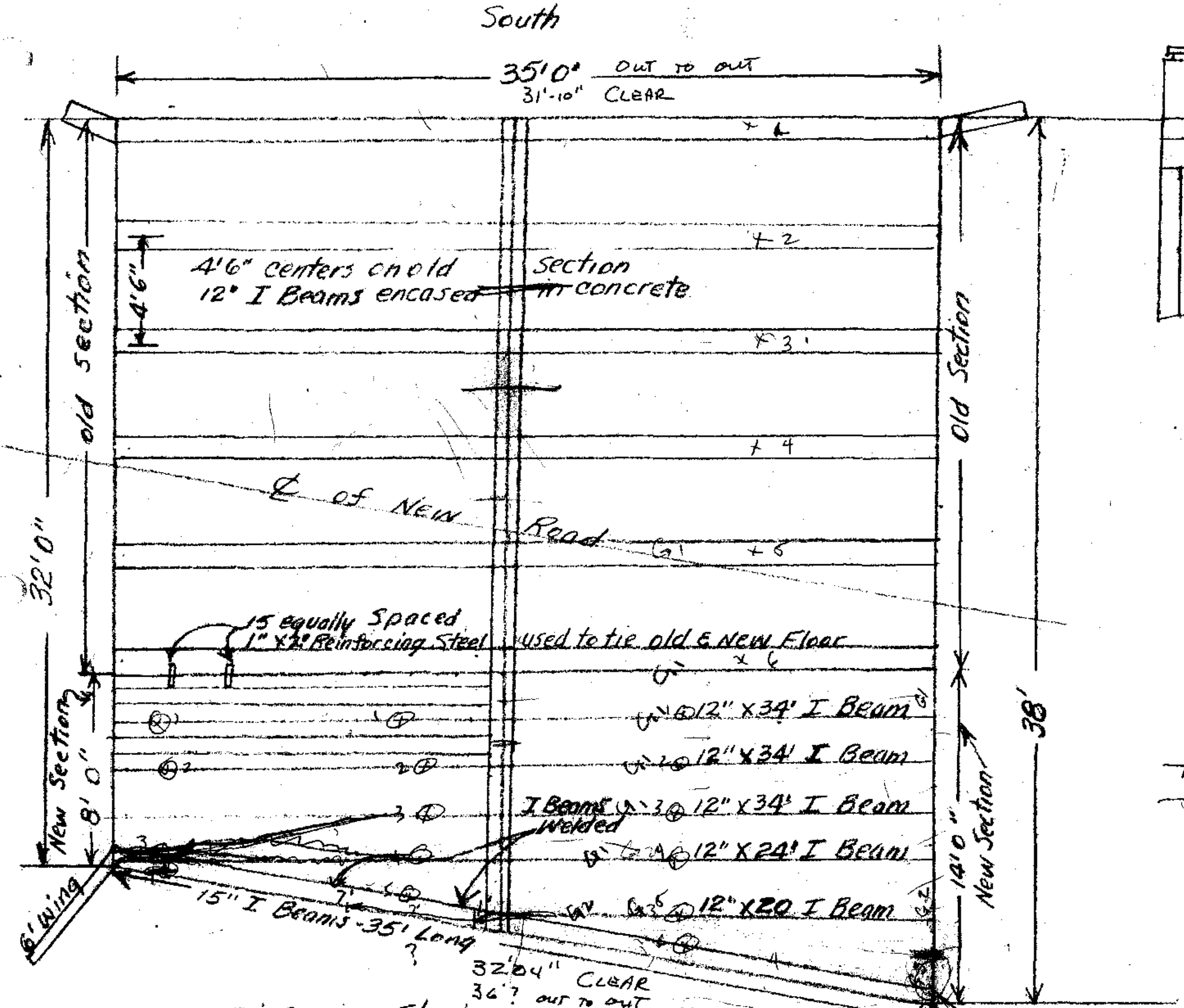


Cost Estimate

	Excavation	$50.00
($14 per yd inc. forms)	67 Cu. yds. 1:4 Concrete	938.00
8 cts. per lb	9000# Reinforcement	720.00
	Total	1708.00

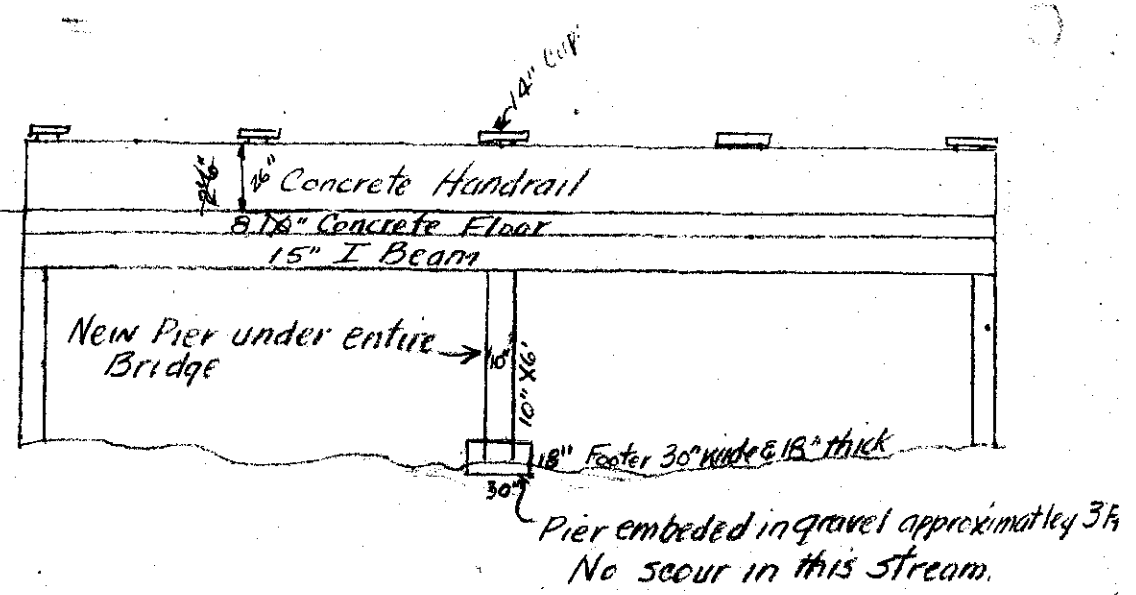


SECTION
Scale ½"=1'

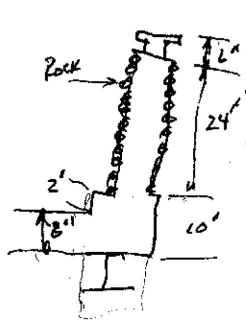


8-5/8" Reinforcing Steel running lengthwise.
6-5/8" Reinforcing Steel running crosswise.
Upon which is a mat of 1/4"x4" Steel Mesh.
10" Concrete Floor to match old section.

14/12



ORIG.



Details of Bridge Widening across
Big Creek on SP-8-330-503,
Molina - Plateau City

H-4-G

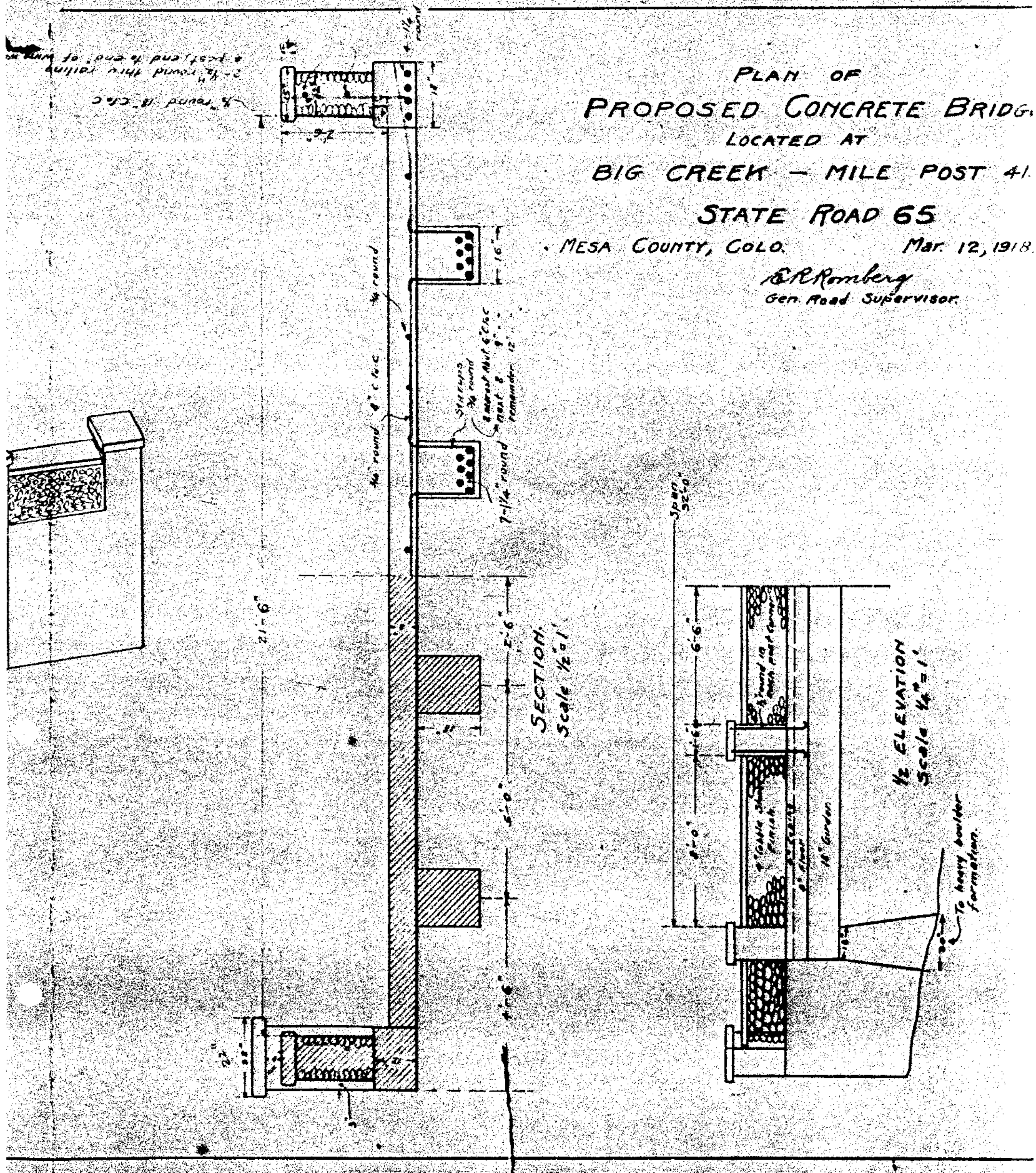
Rerated for 6
Carduv has H-8
No where near
275 246

Check General
Scour = 3
Check Sub Strac.

H-4-G

PLAN OF
PROPOSED CONCRETE BRIDGE
LOCATED AT
BIG CREEK — MILE POST 41
STATE ROAD 65
MESA COUNTY, COLO. Mar. 12, 1918.

E.R. Romberg
Gen. Road Supervisor.



DIVISION OF HIGHWAYS—STATE OF COLORADO
DOH FORM NO 117
REV. DEC 1972

FEDERAL ROAD REGION NO	DISTRICT	PROJ. NO	SHEET NO	TOTAL SHEETS
VIII	COLORADO	BR 5 0330(3)	9	60

AS CONSTRUCTED
REVISED DATE 1-4-75

	REVISIONS		
R-1	6/13/74	ITEM 613	K.D.H.
R2	6-27-74	Replaced Elastomeric Pads with	
		steel Rs I/A/W C.O.# 05765	RRA

GENERAL NOTES

ALL WORK SHALL BE DONE ACCORDING TO THE STANDARD SPECIFICATIONS OF THE DIVISION OF HIGHWAYS, STATE OF COLORADO, APPLICABLE TO THE PROJECT.

ALL CONCRETE SURFACES MARKED WITH THE SYMBOL f AS SHOWN ON DRAWING NO. B 14 SHALL RECEIVE A CLASS 2 SURFACE FINISH.

ALL CONCRETE CHAMFERS SHALL BE 3/4 INCH UNLESS OTHERWISE NOTED.

EXPANSION JOINT MATERIAL SHALL MEET A.A.S.H.O. SPECIFICATION M 213-65 AND SHALL BE INCLUDED IN THE PAYMENT FOR ITEM NO. 601.

SOUNDINGS AND DEPTH OF FOOTINGS ARE IN ACCORDANCE WITH THE BEST AVAILABLE DATA. WHEN DIFFERENT CONDITIONS ARE ENCOUNTERED, THE BRIDGE ENGINEER WILL INSPECT AND DETERMINE IF REDESIGN IS NECESSARY.

WHEN EXCAVATING FOR FOOTINGS, THE FINAL SIX INCHES IN DEPTH SHALL BE DONE BY HAND LABOR METHODS.

FOOTINGS IN ROCK SHALL NOT BE FORMED BUT SHALL BE PLACED AGAINST UNDISTURBED ROCK.

FOR DETAILS OF STRUCTURE EXCAVATION AND STRUCTURE BACKFILL, SEE STANDARD M-206-AA.

ALL STRUCTURAL STEEL NOT OTHERWISE NOTED SHALL BE A.A.S.H.O. SPECIFICATION M-183.

ALL STRUCTURAL STEEL NOT OTHERWISE NOTED SHALL BE PAINTED IN ACCORDANCE WITH SECTION 509 FOR (ALUMINUM) PAINT.

ALL BOLTS SHALL BE 3/4" DIAMETER, HIGH STRENGTH, UNLESS OTHERWISE NOTED.

NO WELDING OF ANY KIND SHALL BE PERMITTED ON THE FLANGES OF STEEL GIRDERS UNLESS SPECIFICALLY CALLED FOR IN THE PLANS.

USE GRADE 60 FOR ALL REINFORCING STEEL, EXCEPT TIES AND STIRRUPS. ALL TIES AND STIRRUPS ARE GRADE 40.

THE FOLLOWING TABLE SHOWS THE MINIMUM LAP FOR COMMON BAR SIZES.

BAR SIZE NUMBER		4	5	6	7	8	9	10	11
SPLICE	GRADE 40	1'-0"	1'-3"	1'-6"	1'-9"	2'-2"	2'-8"	3'-5"	4'-3"
LENGTH	GRADE 60	1'-6"	1'-11"	2'-3"	2'-8"	3'-0"	3'-5"	4'-2"	5'-0"

E. F. = EACH FACE
N. F. = NEAR FACE
F. F. = FAR FACE

CROSS REFERENCE DRAWING NUMBER
B
SECTION OR DETAIL IDENTIFICATION

Concrete Deck Shall Recieve a Transverse Fiber Broom Finish
Location of all construction joints shall be approved by the engineer.

	INITIAL	DATE
DESIGNED BY / CHECKED BY	RRA	4-73
DETAILED BY / CHECKED BY	J.H.	8-73
QUANTITIES BY / CHECKED BY	L.S.	8-73
	B.E.	8-73

SUMMARY OF QUANTITIES   REFERENCE Bk 1, Pg. 17

ITEM	DESCRIPTION	UNIT	Super-structure	Abut. 1	Pier 2	Abut. 3	Totals
202	Removal of Bridge	Ea.					1
204	Haul	Ton Mi	57				57
206	Structure Excavation	Cu. Yd.		234	65	264	563
206	Structure Backfill (Class 2)	Cu. Yd		52	38	54	144
403	Hot Bituminous Pavement (Grading E)	Ton	53				53
411	Asphalt Cement (AC-5)	Ton	3.08 ~~3~~				3.08 ~~3~~
502	Steel Piling (HP 12 x 74)	Lin. Ft		161 ~~165~~	85 ~~92~~	123 ~~120~~	369 ~~377~~
502	Steel Piling (HP12X74) Cut off	Lin. Ft.		12	17	12	41
502	Reinforcing Tips	Ea.		5	8	5	18
506	Heavy Riprap	Cu. Yd		684.5 ~~540~~		578.5 ~~738~~	1263 ~~1278~~
509	Structural Steel	lb.			453		453
509	Structural Steel (Galvanized)	lb.	12,785				12,785
601	Concrete Class A (Bridge)	Cu Yd		22.5	106.5	26.0	155
601	Concrete Class D (Bridge)	Cu. Yd	168.0	39.0	40.3	41.7	289
602	Reinforcing Steel	lb.	49,386	6,461	6,964	6,262	69,073
606	Guard Rail Type 3A	Lin Ft	414				414
R-1 613	Place Conduit	Lin. Ft	428				428
618	Prestressed Conc. Unit (I Section) 80' to 85'-0"	Ea.	10				10
R2 (1)	Steel Masonry Plates	Ea.		5	10	5	20

(1) To Be Included in the Bid Price for Item 618 Prestressed Concrete Units

INDEX OF DRAWINGS

BRIDGE DESCRIPTION

2 - Cont. Spans (80'-0", 80'-0")
Concrete Slab and Prestressed Girder Bridge

LOADING DATA

LIVELOAD: A.A.S.H.O. HS 20-44 OR INTERSTATE ALTERNATE
DEADLOAD: ASSUMES 25 LBS. PER SQ. FT. FOR BITUMINOUS PAVEMENT

DESIGN DATA

A.A.S.H.O. UNIT STRESSES, EXCEPT AS NOTED.

REINFORCING STEEL   Fs = 24,000 LBS. PER SQ. IN. EXCEPT
Fs = 20,000 LBS. PER SQ. IN. IN TRANSVERSE DECK SLAB, STIRRUPS AND TIES.

STRUCTURAL STEEL: A36   Fs = 20,000 LBS. PER SQ. IN.
A572, GRADE 50   Fs = 27,000 LBS. PER SQ. IN.

CONCRETE: Fc = 1,200 LBS. PER SQ. IN.
n = 10

Over Plateau Creek
36' Roadway Curb to Curb 40° 00' Skew
1'-3" Curbs, Standard Bridge Rail Type 3

PAUL CHOVARSKY JR. REGISTERED PROFESSIONAL ENGINEER 4687 STATE OF COLORADO

Approved
[illegible] 11-1-73
Bridge Engineer   Date

DIVISION OF HIGHWAYS

GENERAL INFORMATION
SUMMARY OF QUANTITIES

Station 102+81.15 to 104+49.97
Station

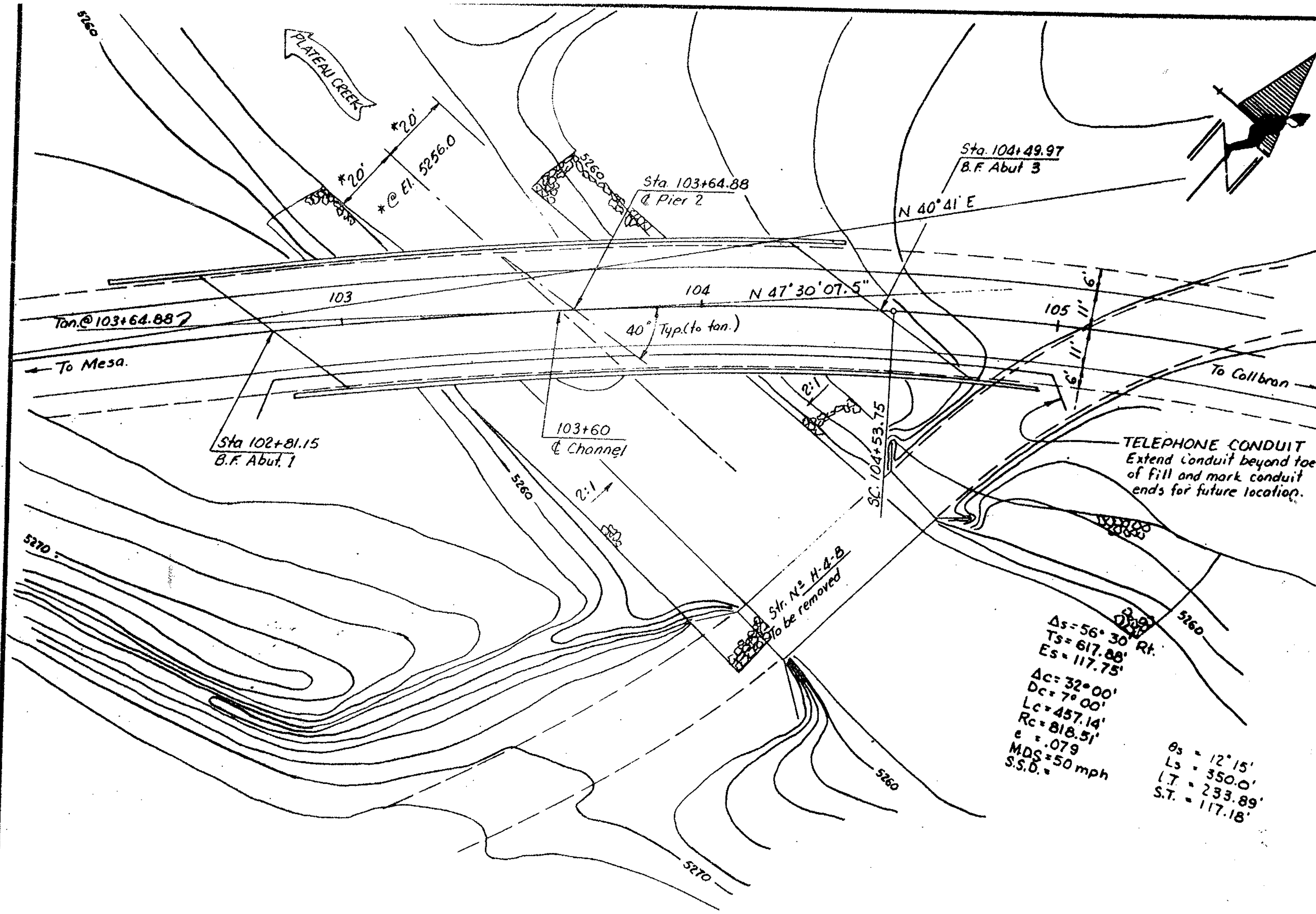
Near Molina   Sec. 16   T. 10S   R. 96 W
Designer R. AKIN   Structure Numbers H-4-S
Detailer L. Sims
Drawing Number B 1 of 15 Drawings

O(4-1-73)

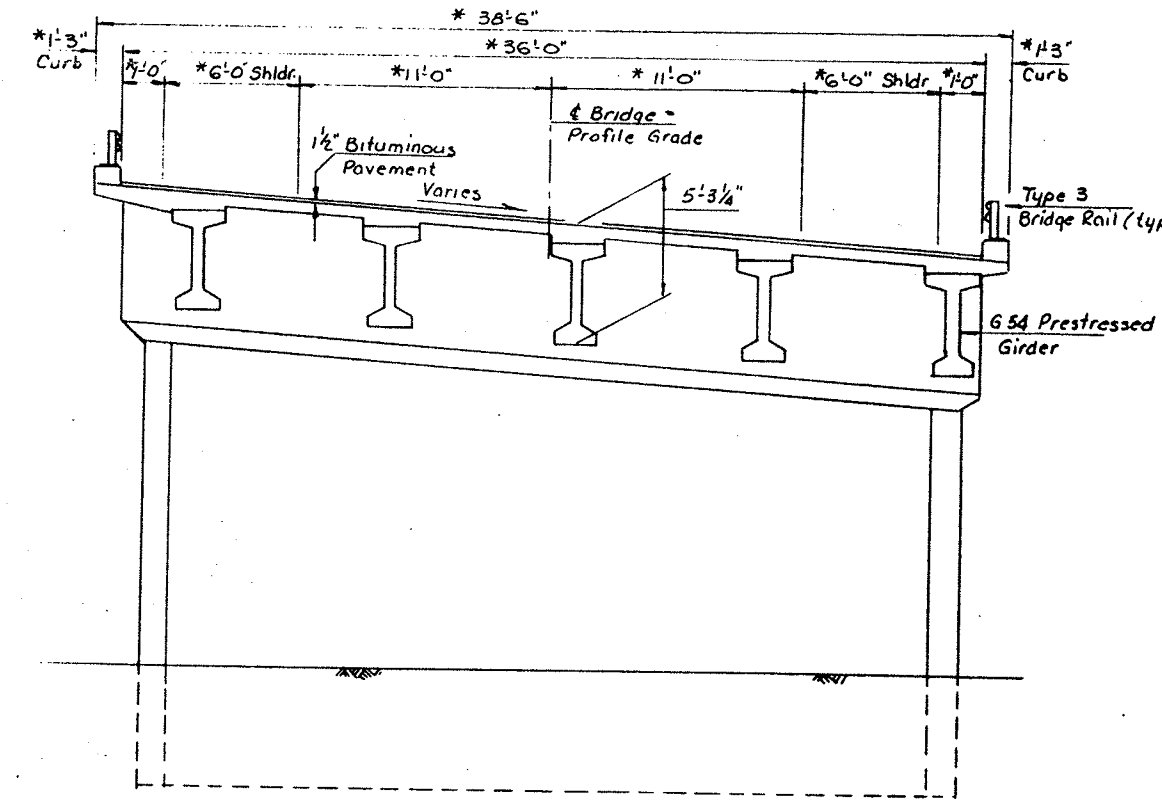
AS CONSTRUCTED
REVISED DATE 1-4-75

FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	BRS 0330(3)	10	60

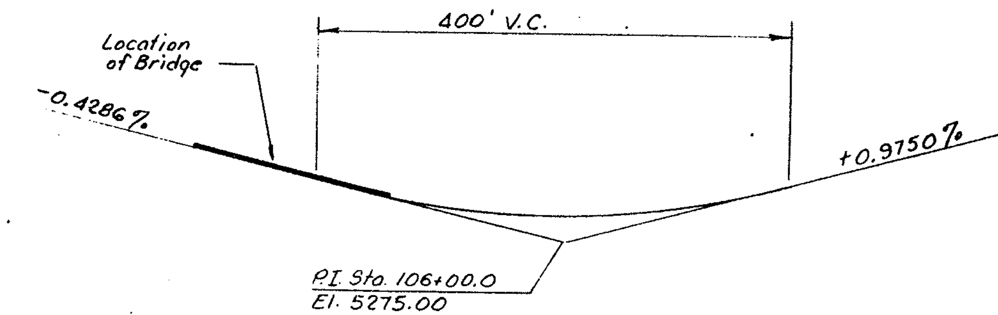
REVISIONS



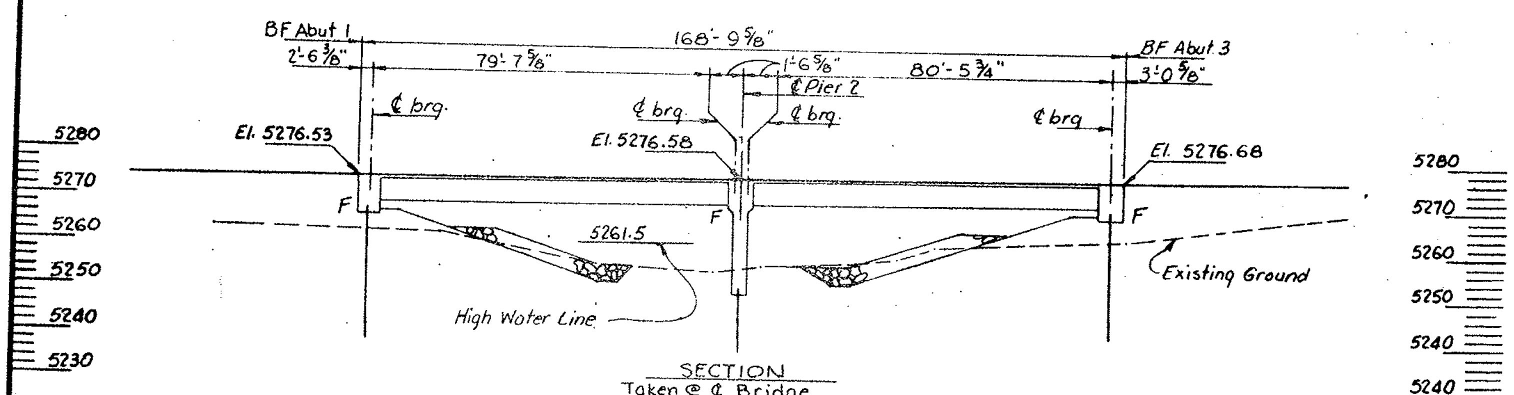
PLAN



TYPICAL SECTION



PROFILE GRADE



SECTION
Taken @ ℄ Bridge
Elevations are finished grade

Pile Size	Location	~~EST.~~ TIP ELEV. N. SIDE	S. SIDE
HP 12x74	Abut 1	52~~37.0~~ 39.9	52~~35.~~ 38.8
HP 12x74	Pier 2	52~~45.0~~ 42.3	52~~37.0~~ 40.1
HP 12x74	Abut 3	52~~50.0~~ 48.8	52~~40.0~~ 43.7

Piles are end bearing

See Bk 1, Pg 15

Live Load: HS 20-44 or Interstate Alternate

DIVISION OF HIGHWAYS

GENERAL LAYOUT

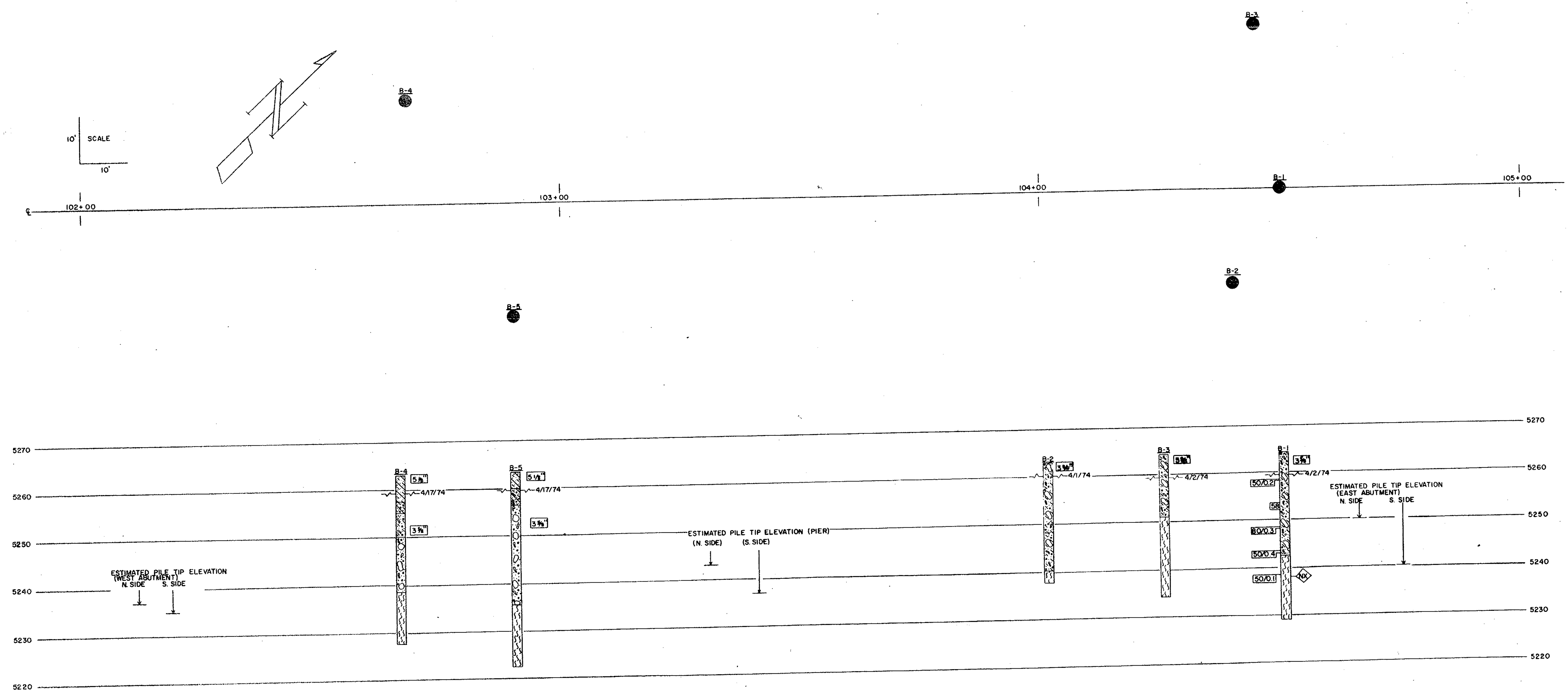
Designer	R. Akin	Structure Numbers	H-4-S
Detailer	R. Akin		
Drawing Number B 2	of 15	Drawings	

Revision Dates (Preliminary Stage Only)

	INITIAL	DATE			
DESIGNED BY	R.R.A.	4-73	CHECKED BY	B.D.E.	8-73
CHECKED BY	J.H.	8-73	QUANTITIES BY	L.S.	8-73
DETAILED BY	R.R.A.	4-74	CHECKED BY	B.D.E.	8-73

FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.	TOTAL SHEETS
VIII	COLO.	BRS C330(3)	11	60

AS CONSTRUCTED
NO REVISIONS DATE 1-4-75



SUMMARY OF TEST RESULTS

Sample No.	Depth	Classification: Corps of Engrs. or Visual	Classification: AASHO	Grading Analysis Percent: Gravel	Coarse Sand	Fine Sand	Silt and Clay	Atterberg Limits: Liquid Limit L_w	Plastic Limit P_w	Plastic Index I_w	Water Cont. w %	Wet Unit Weight γ P.C.F.	Unconfined Strength Q_u T.S.F.	Triaxial Shear Strength Unconsolidated: ø °	C T.S.F.	Consolidated: ø °	C T.S.F.	Time hrs.	Press P.S.I.	Dia. Of Sample (Inches)

TYPE OF MATERIAL

- SANDSTONE
- SILTY, CLAYEY SAND
- SILTY SAND & GRAVEL W/COBBLES & BOULDERS
- SILTY, CLAYEY SAND & GRAVEL
- SILTY SAND & GRAVEL W/COBBLES
- SAND & GRAVEL W/COBBLES & BOULDERS
- SILTY, CLAYEY SAND & GRAVEL W/COBBLES

LEGEND

TEST BORING
3" Hole Size
1-A Sample No.
Blows Per Foot (Standard Penetration Test) 30
Water Table 2/16/67
* 2 in. O.D. Split-Tube Sampler
140 Lb. Hammer
30 in. Free Fall
NX Core Size

CONTINUOUS PENETRATION TEST
2 in. Dia. Drive Point
140 Lb. Hammer
30 in. Free Fall
0 50 100
Blows per Foot

- Location of Test Boring
- Location of Continuous Penetration Test
- Rotary Boring
- Auger Boring
- Core Boring

STRUCTURE NO. H-4-S
DWG. NO. B 3 OF 15

DIVISION OF HIGHWAYS
STATE OF COLORADO

ENGINEERING GEOLOGY

Across PLATEAU CREEK
Sta.
Near MOLINA Sec. 16 T10 S R96 W
Geologist E.C.C.
Made by D.L.S.
Checked by D.L.S.
Approved by Bridge Engineer
Date: 19

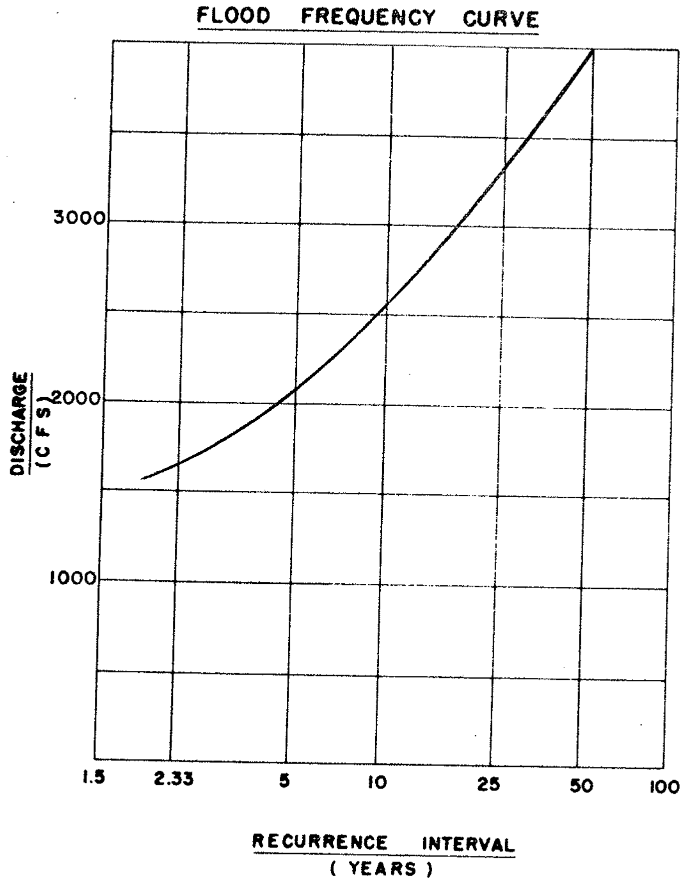
FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	BRS 0330(3)	12	60

AS CONSTRUCTED
NO REVISIONS DATE 1-4-75

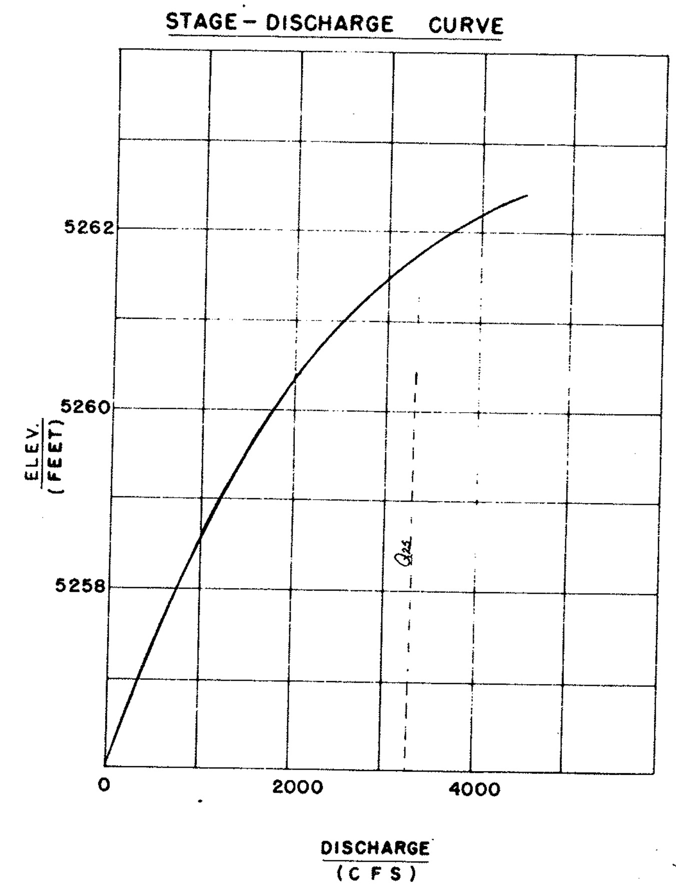
REVISIONS

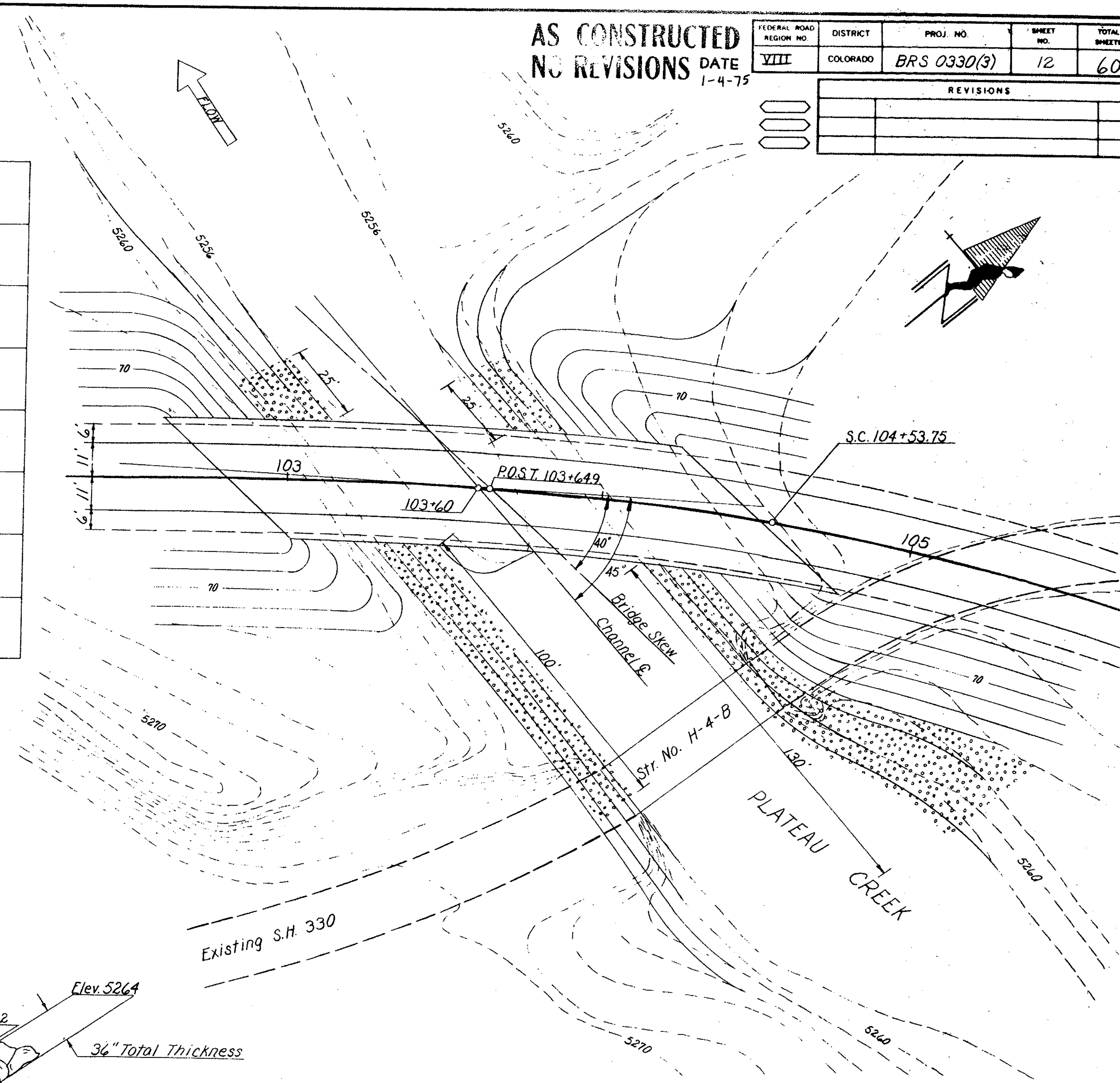
BRIDGE HYDRAULIC INFORMATION

FLOOD FREQUENCY CURVE



STAGE - DISCHARGE CURVE





SUMMARIZED STREAM DATA

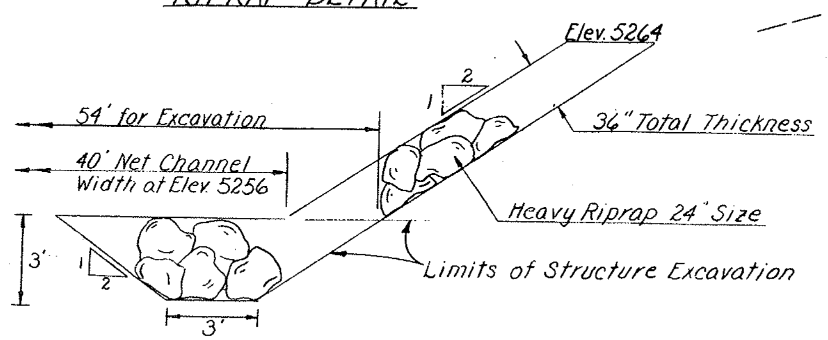
NATURAL (BEFORE NEW CONSTRUCTION)

1. Drainage Area (or Water Right) 484 Sq. Mi
2. Average Slope of Streambed 0.013 Ft./Ft.
3. Description of Channel See No. 10
4. Stability of Channel: Stable ☒ Aggrading ☐ Degrading ☐
5. Drift: Insignificant ☒ Brush & Debris ☐ Large Trees & Logs ☐ Other
6. Ice: Yes ☐ No ☐ Unknown ☒
7. Streambed Elevation 5256.0
8. Design Flow Elevation ~5261.5
9. Maximum Velocity at Design Flow 9 FPS
10. Remarks Channel stable with gravel and cobbles in bottom. Overbank lined with brush, grass, and trees.

DESIGN (AFTER NEW CONSTRUCTION)

1. Design Frequency 25 Year
2. Design Discharge (or Water Right) 3300 CFS
3. Source of Design Discharge Analysis of USGS stream gages.
4. Water Surface Elevation at Upstream Edge of Structure ~5262.0
5. Maximum Backwater Increase Due To Structure 1.5 Ft.
6. Velocity Through Structure at Design Flow (Average) 11.0 FPS (Maximum) 12.5 FPS
7. Remarks:

RIPRAP DETAIL



Riprap
Existing Contours
Finish Contours

DIVISION OF HIGHWAYS		
BRIDGE HYDRAULIC INFORMATION for PLATEAU CREEK		
Approved: D. Roupp Hydraulic Engineer	Designer: D. Hogan	Detailer:
	Structure Numbers: H-4-S	
Date: APR. 15, 1974	DWG. No. B 4 OF 15	

DESIGNED BY / CHECKED BY / DETAILED BY / CHECKED BY / QUANTITIES BY / CHECKED BY / INITIAL / DATE

FEDERAL ROAD REGION NO	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	BRS 0330(3)	13	60

REVISIONS

AS CONSTRUCTED
NO REVISIONS DATE 1-4-75

	INITIAL	DATE			
DESIGNED BY	RRA	4-73	CHECKED BY	BDE	8-73
CHECKED BY	J.H.	4-73	QUANTITIES BY	L.S.	8-73
DETAILED BY	L.S	9-73	CHECKED BY	B.D.E.	8-73

STATE HIGHWAY NO. 330
OVER PLATEAU CREEK
STRUCTURE NO H-4-5
DESIGNED RRA 6-1-73
DETAILED AND INPUT RRA 7-5-73
ALL ELEVATIONS ARE 0.125
FEET BELOW FINISHED GRADE
ELEVATIONS

INPUT DATA FOR BRIDGE H-4-5

```
BT    =  101 +  3.7500  ALPHA = -43 10 52.00  NCON = -1000.0000  GBK  = -.4286
PI    =  106 +  0.0000     DC =   7  0  0.00  WCON =  1000.0000  GAM  =  .9750
POS   =  103 + 64.8800  THETA =  12 15  0.00    LS =      350  MAX  = .0790
CLOFF =    0.0000  EPI =  5274.8750   VC =      400  MIN  =  .0200
                TYPE = 1 PVOFF =  17.0000 STLPL =    0.0000
```

	STATION	ELEVATION
ABUT 1 END OF WING		
WEST OUTSIDE	102 + 37.57	5276.77
EAST OUTSIDE	102 + 84.50	5275.82
ABUT 1 BACKFACE		
WEST OUT	102 + 61.34	5276.88
WEST INSIDE	102 + 62.60	5276.85
TAN AT POS	102 + 77.95	5276.50
CL OF BRIDGE	102 + 81.15	5276.41
EAST INSIDE	103 + .36	5275.78
EAST OUTSIDE	103 + 1.72	5275.73

CL BRG ABUT 1
CL SO BRG ABUT 1

	STATION	ELEVATION
WEST OUTSIDE		
STA BACK	102 + 63.82	5276.89
1 10TH	102 + 71.37	5276.94
2 10TH	102 + 78.96	5276.98
3 10TH	102 + 86.59	5277.03
4 10TH	102 + 94.24	5277.07
5 10TH	103 + 1.94	5277.12
6 10TH	103 + 9.68	5277.17
7 10TH	103 + 17.46	5277.21
8 10TH	103 + 25.28	5277.26
9 10TH	103 + 33.16	5277.31
STA AHEAD	103 + 41.08	5277.35
GIRDER 1		
STA BACK	102 + 66.37	5276.84
1 10TH	102 + 74.29	5276.87
2 10TH	102 + 82.20	5276.91
3 10TH	102 + 90.12	5276.94
4 10TH	102 + 98.03	5276.97
5 10TH	103 + 5.95	5277.00
6 10TH	103 + 13.86	5277.04
7 10TH	103 + 21.77	5277.07
8 10TH	103 + 29.67	5277.11
9 10TH	103 + 37.58	5277.15
STA AHEAD	103 + 45.48	5277.19
GIRDER 2		
STA BACK	102 + 74.96	5276.65
1 10TH	102 + 82.91	5276.66
2 10TH	102 + 90.87	5276.68
3 10TH	102 + 98.82	5276.69
4 10TH	103 + 6.78	5276.71
5 10TH	103 + 14.74	5276.72
6 10TH	103 + 22.69	5276.74
7 10TH	103 + 30.65	5276.76
8 10TH	103 + 38.60	5276.78
9 10TH	103 + 46.55	5276.81
STA AHEAD	103 + 54.50	5276.84
GIRDER 3		
STA BACK	102 + 83.62	5276.42
1 10TH	102 + 91.62	5276.41
2 10TH	102 + 99.62	5276.41
3 10TH	103 + 7.62	5276.41
4 10TH	103 + 15.62	5276.41
5 10TH	103 + 23.63	5276.41
6 10TH	103 + 31.63	5276.41
7 10TH	103 + 39.64	5276.41
8 10TH	103 + 47.64	5276.42
9 10TH	103 + 55.64	5276.43
STA AHEAD	103 + 63.64	5276.44
GIRDER 4		
STA BACK	102 + 92.38	5276.15
1 10TH	103 + .42	5276.13
2 10TH	103 + 8.47	5276.10
3 10TH	103 + 16.52	5276.09
4 10TH	103 + 24.57	5276.07
5 10TH	103 + 32.63	5276.05
6 10TH	103 + 40.68	5276.04
7 10TH	103 + 48.74	5276.03
8 10TH	103 + 56.80	5276.02
9 10TH	103 + 64.86	5276.01
STA AHEAD	103 + 72.91	5276.02
GIRDER 5		
STA BACK	103 + 1.24	5275.84
1 10TH	103 + 9.33	5275.80
2 10TH	103 + 17.43	5275.76
3 10TH	103 + 25.53	5275.72
4 10TH	103 + 33.64	5275.69
5 10TH	103 + 41.75	5275.66
6 10TH	103 + 49.86	5275.63
7 10TH	103 + 57.98	5275.60
8 10TH	103 + 66.09	5275.58
9 10TH	103 + 74.21	5275.56
STA AHEAD	103 + 82.33	5275.55
EAST OUTSIDE		
STA BACK	103 + 4.33	5275.72
1 10TH	103 + 12.29	5275.68
2 10TH	103 + 20.31	5275.64
3 10TH	103 + 28.39	5275.60
4 10TH	103 + 36.53	5275.56
5 10TH	103 + 44.74	5275.52
6 10TH	103 + 53.02	5275.48
7 10TH	103 + 61.38	5275.44
8 10TH	103 + 69.81	5275.40
9 10TH	103 + 78.33	5275.36
STA AHEAD	103 + 86.94	5275.31

	STATION	ELEVATION
ABUT 3 BACKFACE		
WEST OUT	104 + 23.50	5277.85
WEST INSIDE	104 + 25.15	5277.78
TAN AT POS	104 + 45.32	5276.79
CL OF BRIDGE	104 + 49.97	5276.55
EAST INSIDE	104 + 77.07	5275.09
EAST OUTSIDE	104 + 79.05	5274.99

CL NO BRG PIER 2
CL BRG ABUT 3

	STATION	ELEVATION
WEST OUTSIDE		
STA BACK	103 + 44.08	5277.37
1 10TH	103 + 51.46	5277.42
2 10TH	103 + 58.89	5277.46
3 10TH	103 + 66.37	5277.50
4 10TH	103 + 73.92	5277.55
5 10TH	103 + 81.52	5277.59
6 10TH	103 + 89.20	5277.64
7 10TH	103 + 96.94	5277.69
8 10TH	104 + 4.75	5277.73
9 10TH	104 + 12.65	5277.78
STA AHEAD	104 + 20.63	5277.84
GIRDER 1		
STA BACK	103 + 47.14	5277.26
1 10TH	103 + 55.02	5277.28
2 10TH	103 + 62.90	5277.30
3 10TH	103 + 70.78	5277.32
4 10TH	103 + 78.66	5277.35
5 10TH	103 + 86.54	5277.38
6 10TH	103 + 94.42	5277.41
7 10TH	104 + 2.30	5277.44
8 10TH	104 + 10.18	5277.48
9 10TH	104 + 18.05	5277.53
STA AHEAD	104 + 25.91	5277.59
GIRDER 2		
STA BACK	103 + 56.93	5276.87
1 10TH	103 + 64.86	5276.87
2 10TH	103 + 72.80	5276.88
3 10TH	103 + 80.74	5276.89
4 10TH	103 + 88.69	5276.90
5 10TH	103 + 96.63	5276.91
6 10TH	104 + 4.57	5276.93
7 10TH	104 + 12.51	5276.96
8 10TH	104 + 20.45	5276.99
9 10TH	104 + 28.39	5277.03
STA AHEAD	104 + 36.31	5277.08
GIRDER 3		
STA BACK	103 + 66.86	5276.44
1 10TH	103 + 74.86	5276.43
2 10TH	103 + 82.86	5276.42
3 10TH	103 + 90.87	5276.41
4 10TH	103 + 98.88	5276.41
5 10TH	104 + 6.88	5276.41
6 10TH	104 + 14.89	5276.42
7 10TH	104 + 22.90	5276.44
8 10TH	104 + 30.90	5276.46
9 10TH	104 + 38.90	5276.50
STA AHEAD	104 + 46.90	5276.54
GIRDER 4		
STA BACK	103 + 76.95	5275.97
1 10TH	103 + 85.01	5275.94
2 10TH	103 + 93.08	5275.92
3 10TH	104 + 1.16	5275.90
4 10TH	104 + 9.24	5275.88
5 10TH	104 + 17.31	5275.88
6 10TH	104 + 25.39	5275.88
7 10TH	104 + 33.47	5275.89
8 10TH	104 + 41.54	5275.91
9 10TH	104 + 49.61	5275.93
STA AHEAD	104 + 57.67	5275.96
GIRDER 5		
STA BACK	103 + 87.20	5275.45
1 10TH	103 + 95.34	5275.41
2 10TH	104 + 3.48	5275.38
3 10TH	104 + 11.63	5275.35
4 10TH	104 + 19.78	5275.32
5 10TH	104 + 27.93	5275.31
6 10TH	104 + 36.08	5275.30
7 10TH	104 + 44.23	5275.30
8 10TH	104 + 52.37	5275.32
9 10TH	104 + 60.51	5275.34
STA AHEAD	104 + 68.64	5275.36
EAST OUTSIDE		
STA BACK	103 + 90.20	5275.30
1 10TH	103 + 98.26	5275.26
2 10TH	104 + 6.41	5275.22
3 10TH	104 + 14.66	5275.18
4 10TH	104 + 23.01	5275.14
5 10TH	104 + 31.48	5275.11
6 10TH	104 + 40.06	5275.08
7 10TH	104 + 48.77	5275.05
8 10TH	104 + 57.62	5275.03
9 10TH	104 + 66.61	5275.01
STA AHEAD	104 + 75.75	5274.99
ABUT 3 END OF WING		
WEST OUTSIDE	104 + 40.12	5277.97
EAST OUTSIDE	104 + 96.54	5274.96

DIVISION OF HIGHWAYS

ELEVATIONS

Approved:

Bridge Engineer
Date:

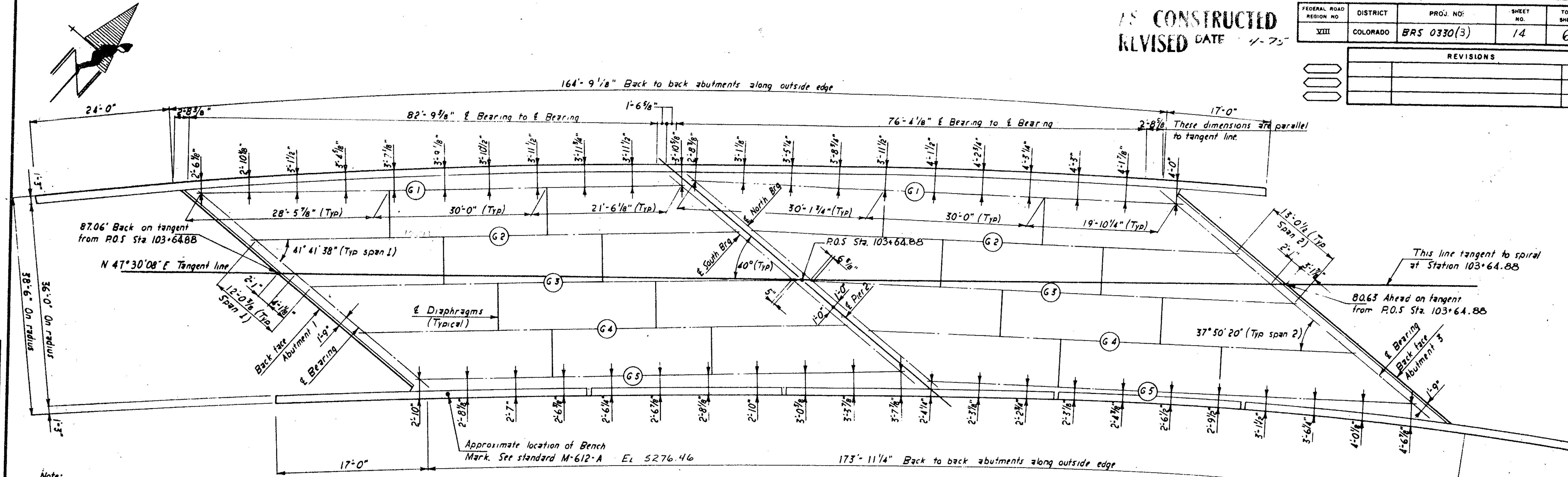
Designer: R Akin
Detailer: L. Sims
Structure Numbers: H-4-5

DWG. No. B 5 OF 15

FEDERAL ROAD REGION NO	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	BRS 0330(3)	14	60

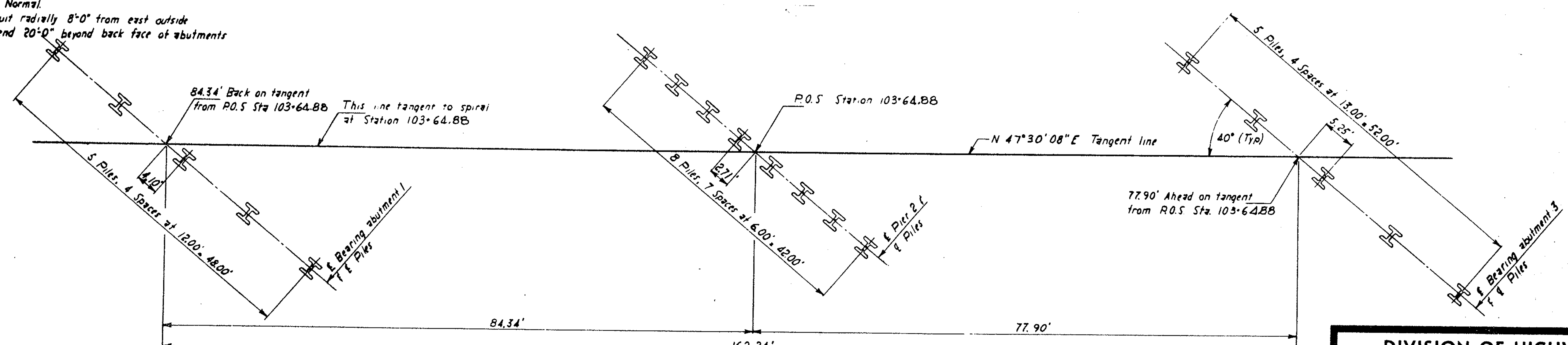
AS CONSTRUCTED
REVISED DATE 4-75

REVISIONS		



Note:
All curb offsets are spaced at 10 th points of the span lengths
For Bridge Rail Type 3 details see DWG. No B 13
Two 1'-0" curb cuts each span low side only, third points
(Cut interfering reinforcing and place to avoid Bridge Posts)
Girder spacing 8'-0" Normal.
Place Telephone Conduit radially 8'-0" from east outside edge of deck and extend 20'-0" beyond back face of abutments

CONSTRUCTION LAYOUT



PILING LAYOUT

Notes:
The piling dimensions shown are at the bottom of the concrete
All piling to be HP 12 x 74 with a maximum pile load of 86 tons at abutment 1, 89 tons at pier 2 and 92 tons at abutment 3

	INITIAL	DATE
DESIGNED BY	RRA	6-73
CHECKED BY	B.D.E.	8-73
DETAILED BY	J.H.	6-73
QUANTITIES BY	L.S.	8-73
CHECKED BY	R.J.S.	7-73
CHECKED BY	P.E.	8-73

DIVISION OF HIGHWAYS

CONSTRUCTION AND PILING LAYOUTS

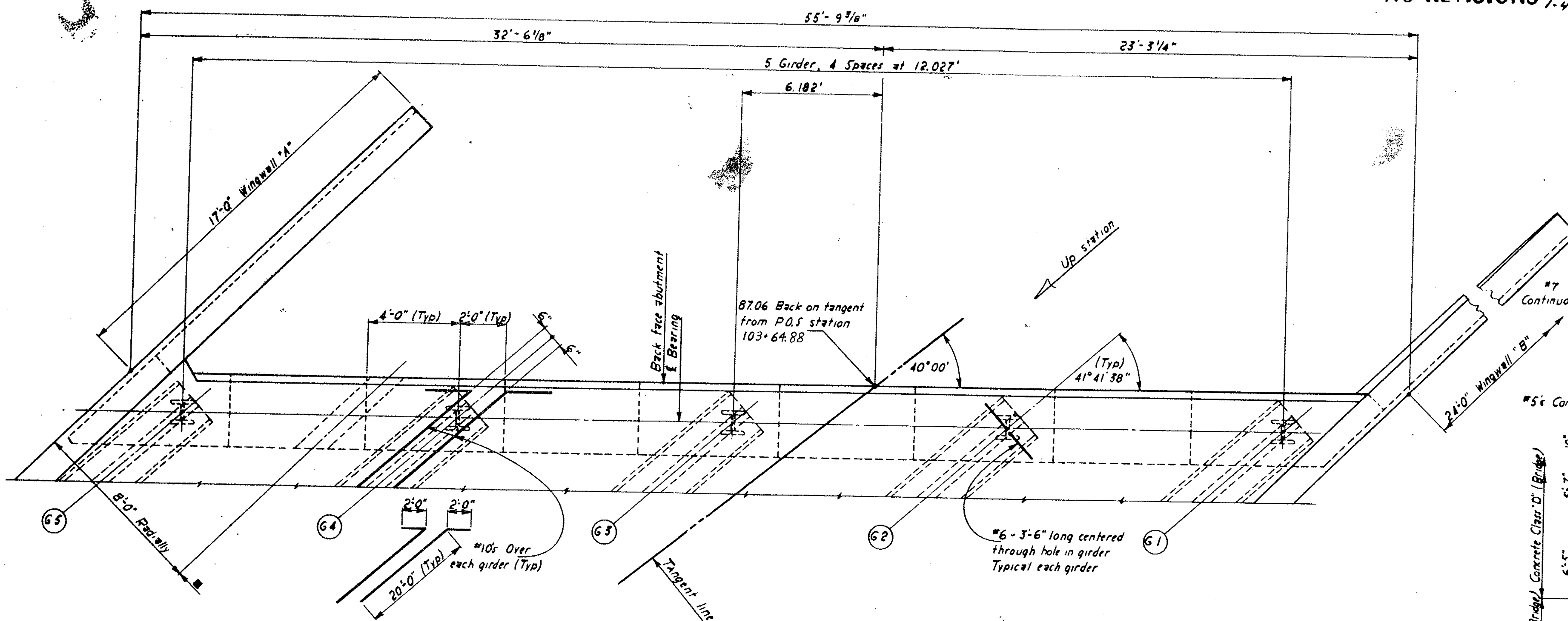
Designer	R Akin	Structure Numbers	H-4-5
Detailer	R Seylhouwer		
Drawing Number B 6		of 15	Drawings

AS CONSTRUCTED
NO REVISIONS DATE 1-4-75

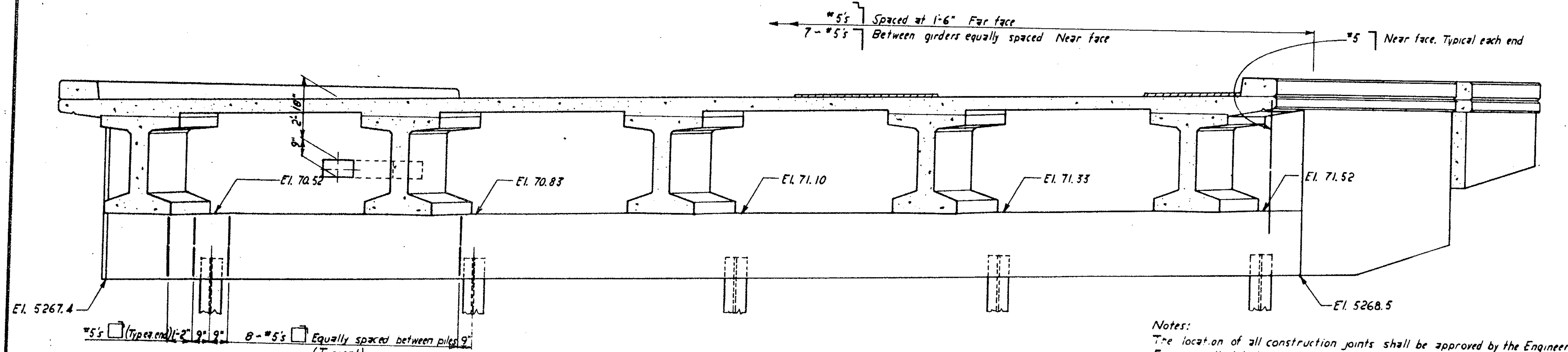
FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	BRS 0330 (3)	15	60

REVISIONS			
R1	6-27-74	Replaced Elastomeric Pads with Steel Pls S/A/W C.O. # 05765	RRA

	INITIAL	DATE			
DESIGNED BY	RRA	6-73	CHECKED BY	B.D.E.	8-73
CHECKED BY	J.H.	8-73	QUANTITIES BY	L.S.	8-73
DETAILED BY	R.J.S.	7-24-73	CHECKED BY	B.E.	8-73

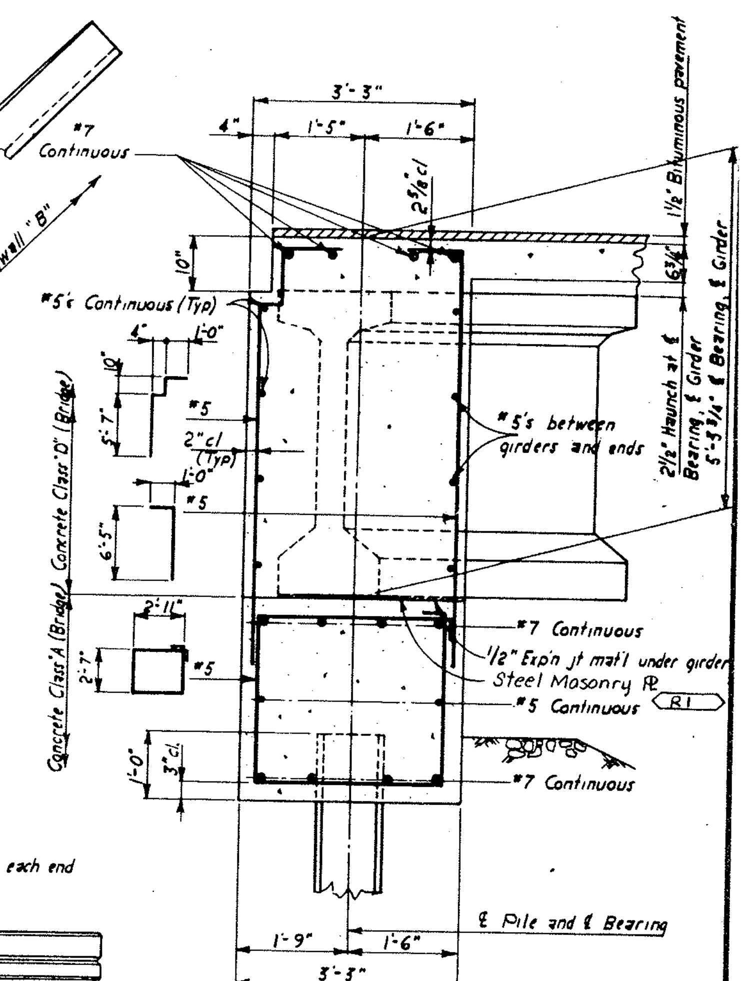


PLAN ~ ABUTMENT 1



ELEVATION ~ ABUTMENT 1

For additional reinforcing steel details see Typical Section Thru Abutment



TYPICAL SECTION THRU ABUTMENT

Notes:
The location of all construction joints shall be approved by the Engineer.
For wingwall details see DWG. No. B. 9
■ 9" x 1'-0" Void through abutment to accommodate Telephone conduit, move interferring reinforcing

DIVISION OF HIGHWAYS

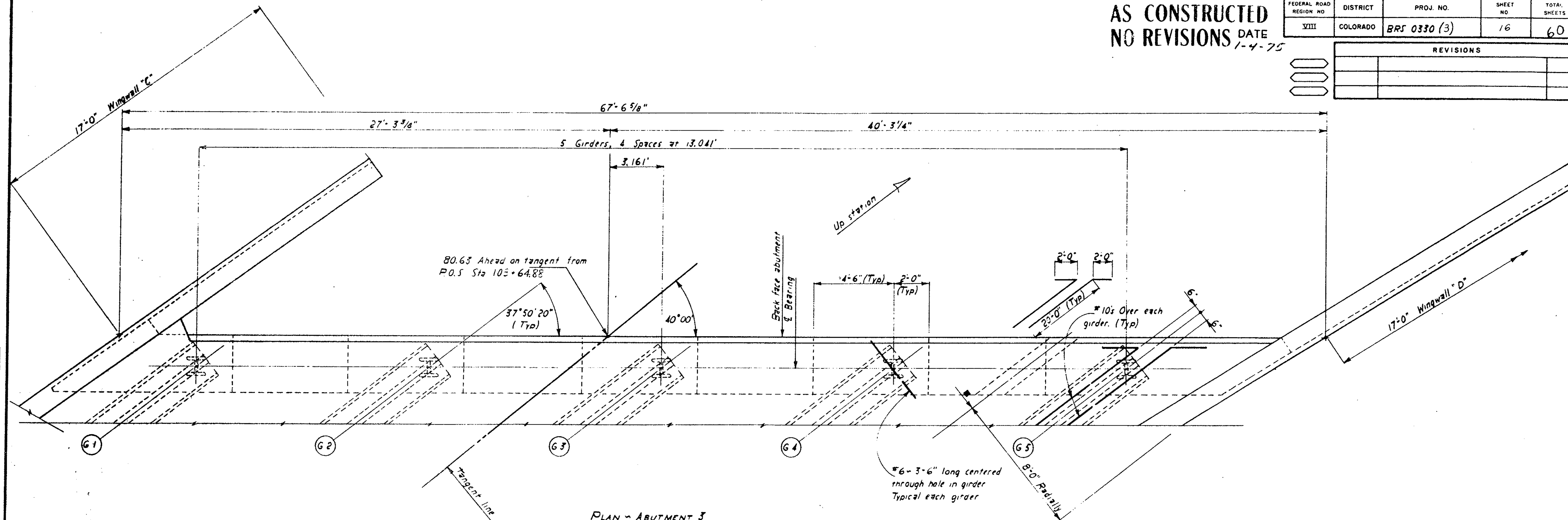
DETAILS ABUTMENT 1

Designer R. Akin		Structure Numbers	H-4-S
Detailer R. Seylhouwer			
Drawing Number B 7	of 15	Drawings	

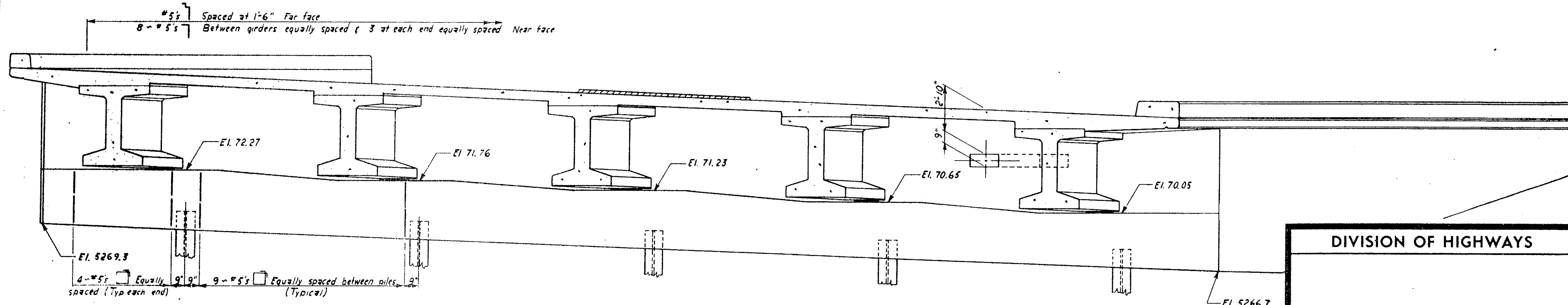
AS CONSTRUCTED
NO REVISIONS DATE 1-4-75

FEDERAL ROAD REGION NO	DISTRICT	PROJ. NO.	SHEET NO	TOTAL SHEETS
VIII	COLORADO	BRS 0330 (3)	16	60

REVISIONS		



PLAN ~ ABUTMENT 3



ELEVATION ~ ABUTMENT 3

For additional reinforcing steel details see Typical Section thru Abutment
See DWG No. B 7

Notes:
The location of all construction joints shall be approved by the Engineer
For wingwall details see DWG No. B 9
■ 9" x 1'-0" Void through abutment to accommodate Telephone conduit, move interfering reinforcing

	INITIAL	DATE		
DESIGNED BY	R.R.A.	6-73	CHECKED BY	B.E. 8-73
CHECKED BY	J.H.	8-73	QUANTITIES BY	L.S. 8-73
DETAILED BY	R.J.S.	7-25-73	CHECKED BY	B.E. 8-73

DIVISION OF HIGHWAYS

DETAILS ABUTMENT 3

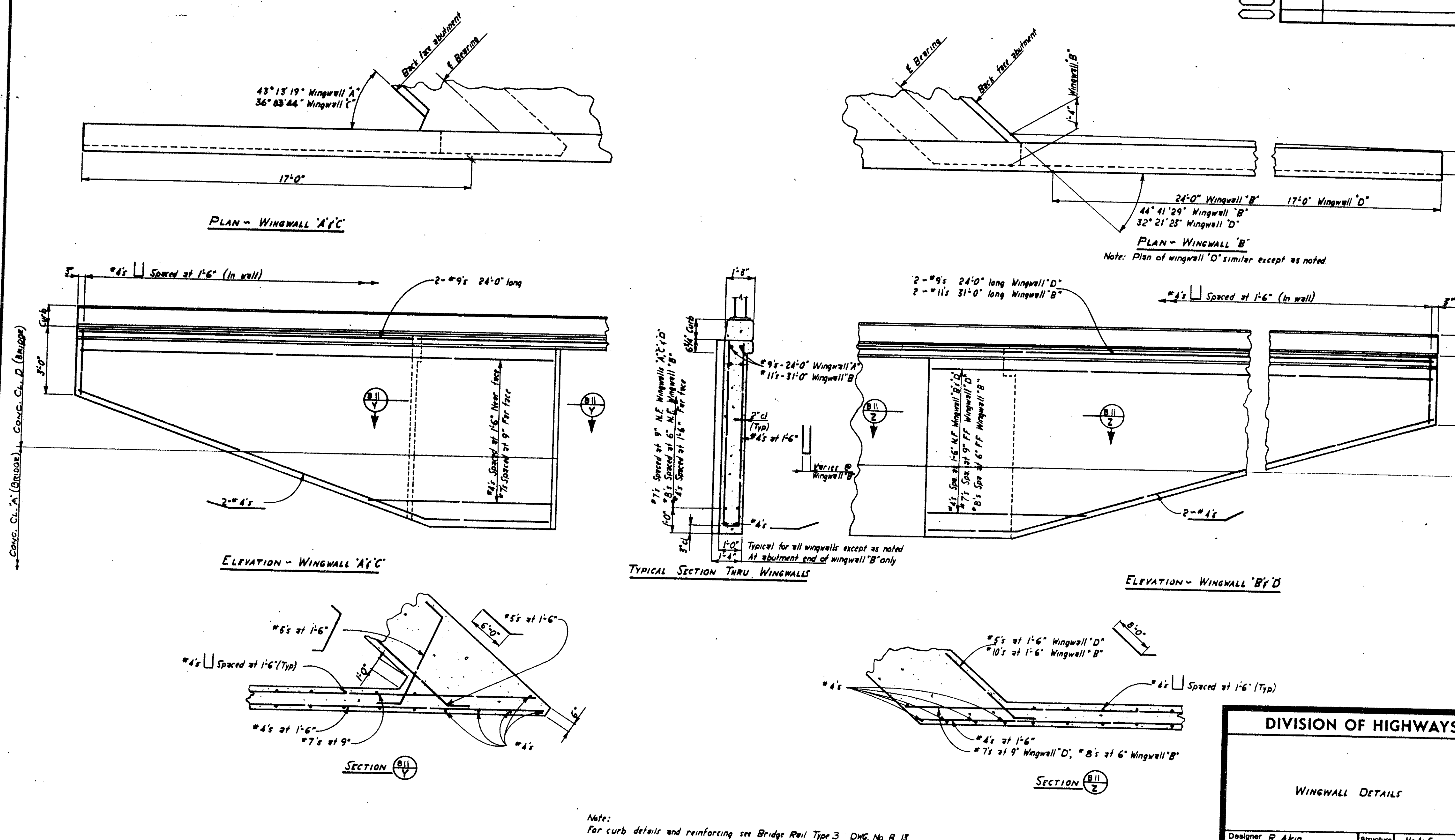
Designer	R Akin	Structure Numbers	H-4-S
Detailer	R Seylhouwer		
Drawing Number B 8		of 15	Drawings

AS CONSTRUCTED
NO REVISIONS DATE 1-4-75

FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	BRS 0330(3)	17	60

REVISIONS

	Initial	Date	Checked by
Designed by	RRA	6-73	B.D.F. 8-73
Checked by	J.H.	8-73	Quantities by J.S. 8-73
Detailed by	P.J.S.	7-73	Checked by B.F. 8-73



Note:
For curb details and reinforcing see Bridge Rail Type 3 DWG. No B 13

DIVISION OF HIGHWAYS

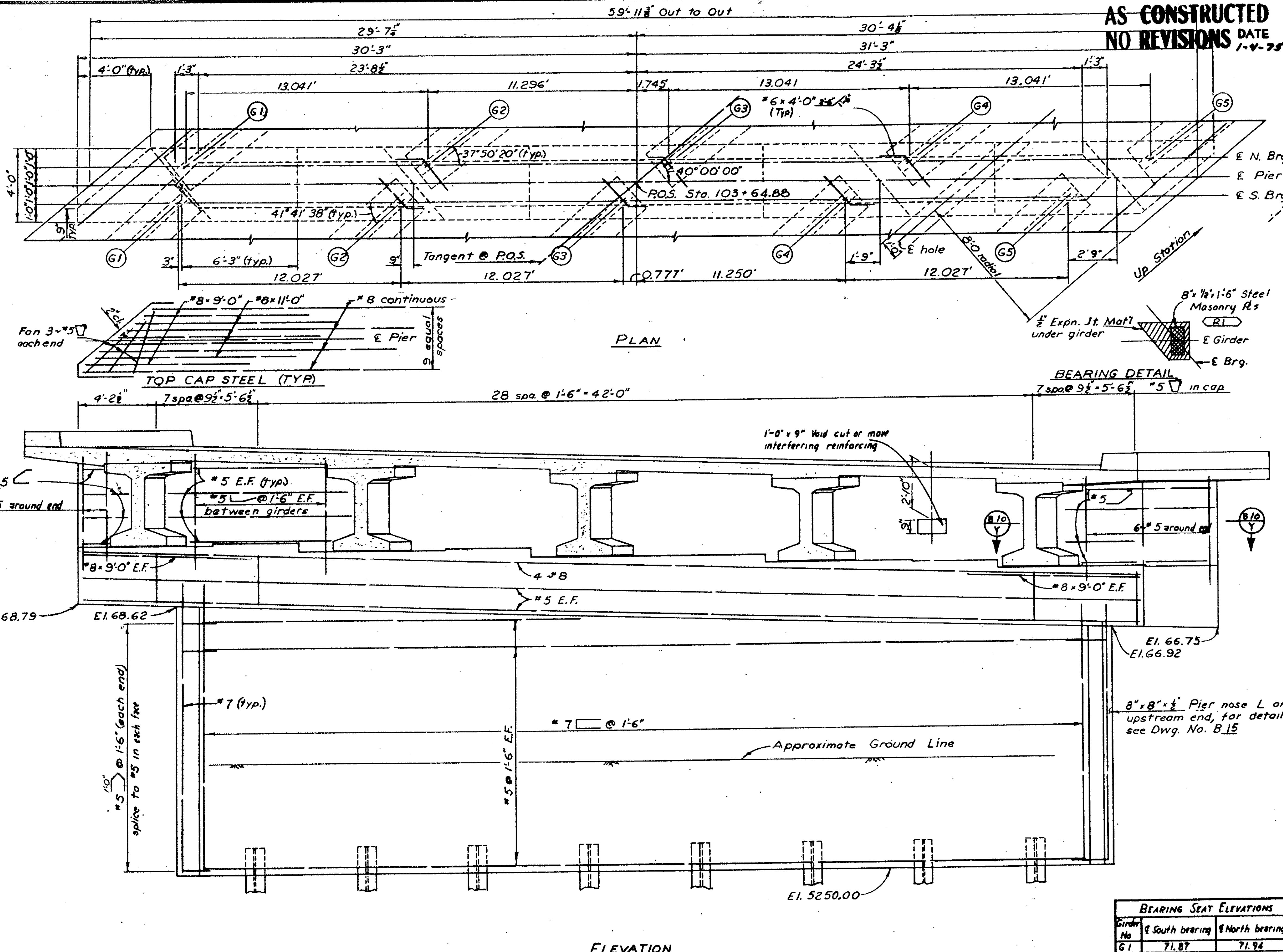
WINGWALL DETAILS

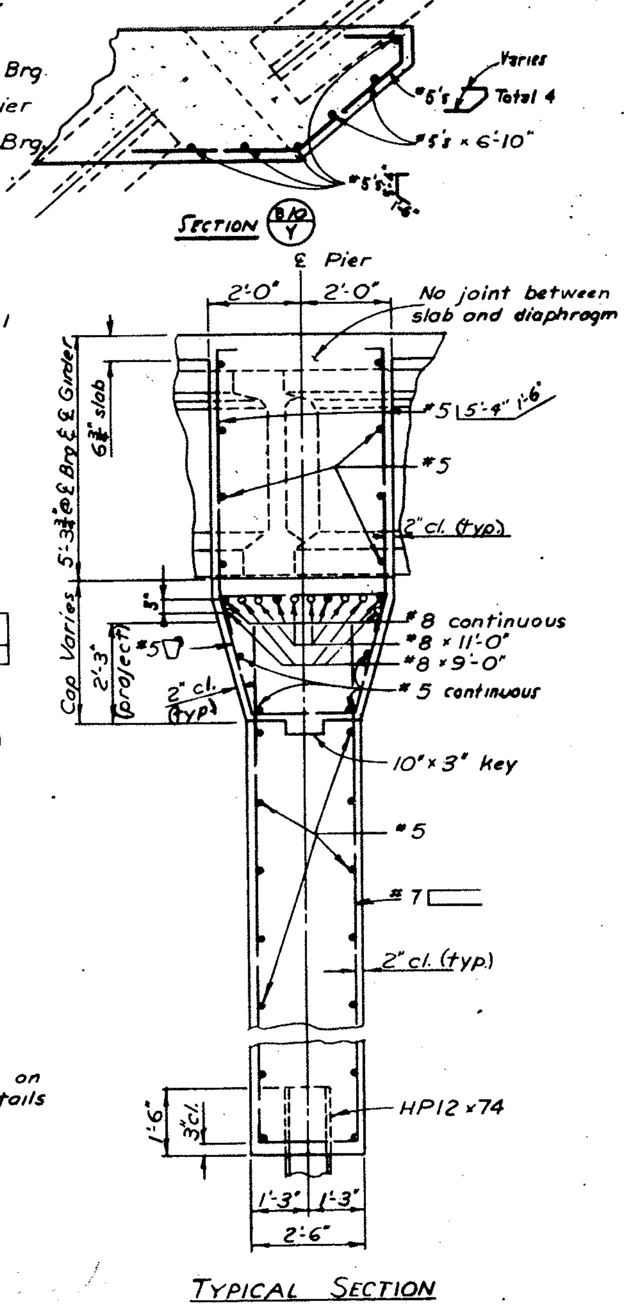
Designer	R. Akin	Structure Numbers	H-4-S
Detailer	R. Seylhouwer		
Drawing Number B 9		of 15	Drawings

AS ~~CONSTRUCTED~~
NO REVISIONS DATE 1-4-75

FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	BR 50330(3)	18	60

REVISIONS			
R1	6-27-74	Replaced Elastomeric Pads with	
		steel Pls I/A/w C.O.# 05765	RRA





BEARING SEAT ELEVATIONS		
Girder No	℄ South bearing	℄ North bearing
G1	71.87	71.94
G2	71.52	71.55
G3	71.13	71.12
G4	70.70	70.65
G5	70.23	70.14

	INITIAL	DATE		
DESIGNED BY	RRA	6-73	CHECKED BY	B.D.E. 8-73
CHECKED BY	J.H.	8-73	QUANTITIES BY	L.S. 8-73
DETAILED BY	EHH	7-73	CHECKED BY	B.E. 8-73

DIVISION OF HIGHWAYS

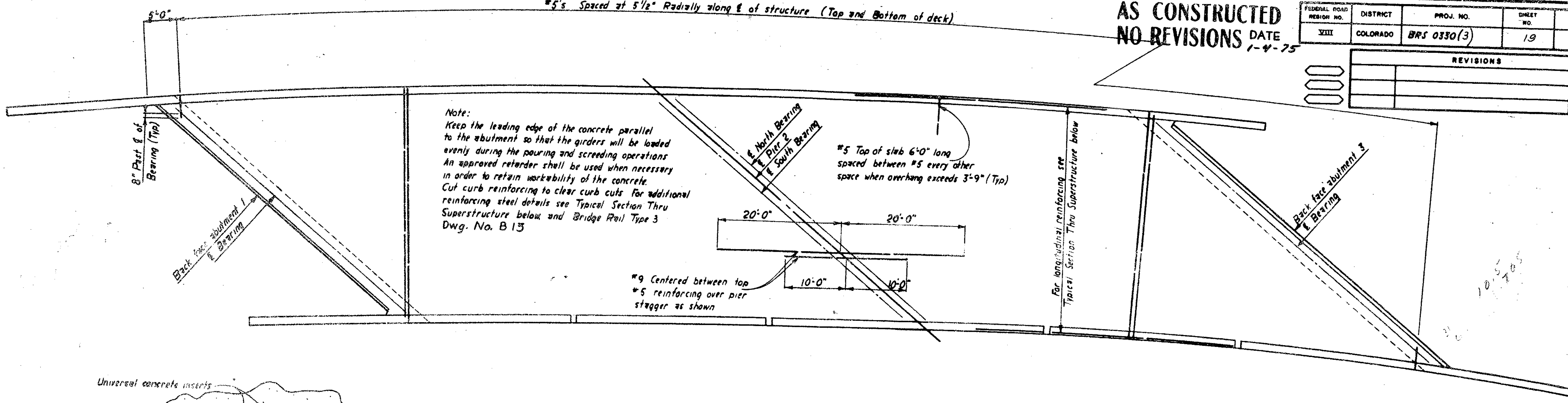
PIER 2 DETAILS

Designer R. Akin
Detailer E. Hadley
Structure Numbers H-4-S
Drawing Number B 10 of 15 Drawings

AS CONSTRUCTED
NO REVISIONS DATE 1-4-75

FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	BRS 0330(3)	19	60

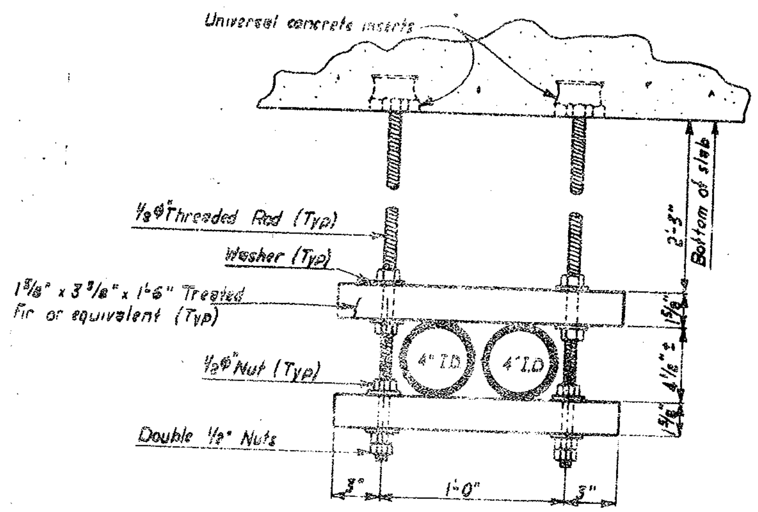
REVISIONS		



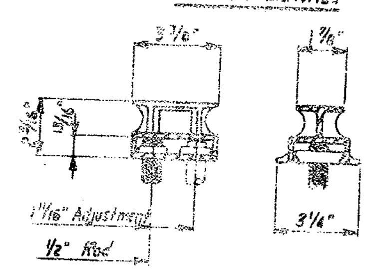
Note:
Keep the leading edge of the concrete parallel to the abutment so that the girders will be loaded evenly during the pouring and screeding operations. An approved retarder shall be used when necessary in order to retain workability of the concrete. Cut curb reinforcing to clear curb cuts. For additional reinforcing steel details see Typical Section Thru Superstructure below and Bridge Rail Type 3 Dwg. No. B 13

SUPERSTRUCTURE REINFORCING

INITIAL	DATE		CHECKED BY	
DESIGNED BY	R.R.A.	6-73	CHECKED BY	B.D.F. 8-73
CHECKED BY	J.H.	8-73	QUANTITIES BY	L.S. 8-73
DETAILED BY	R.T.S.	7-19-73	CHECKED BY	B.F. 8-73

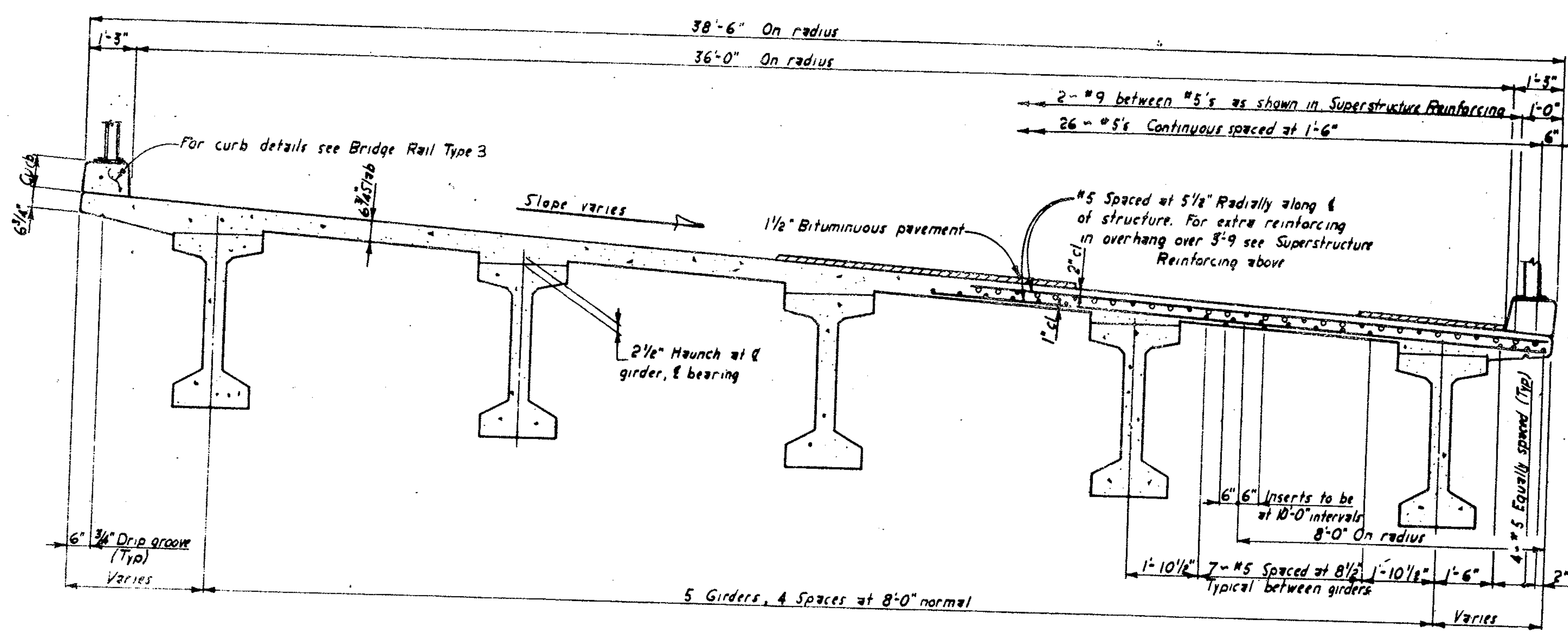


HANGER DETAILS



UNIVERSAL CONCRETE INSERT

Note:
All work and material required to accomplish the above shall be included in the bid for item 613. Conduit to be furnished by others



TYPICAL SECTION THRU SUPERSTRUCTURE
Looking up station

DIVISION OF HIGHWAYS

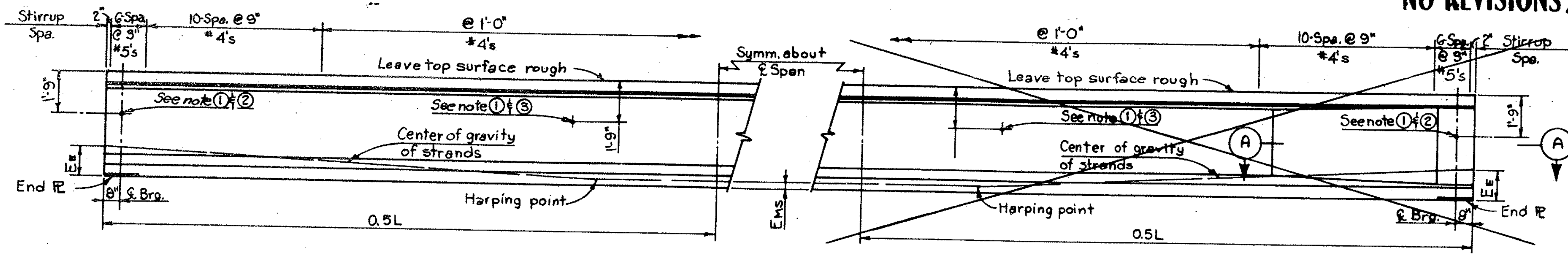
SUPERSTRUCTURE DETAILS

Designer R. Akin		Structure Numbers	H-4-S
Detailer R. Seylhouwer			
Drawing Number B 11		of 15	Drawings

AS CONSTRUCTED
NO REVISIONS DATE 1-4-75

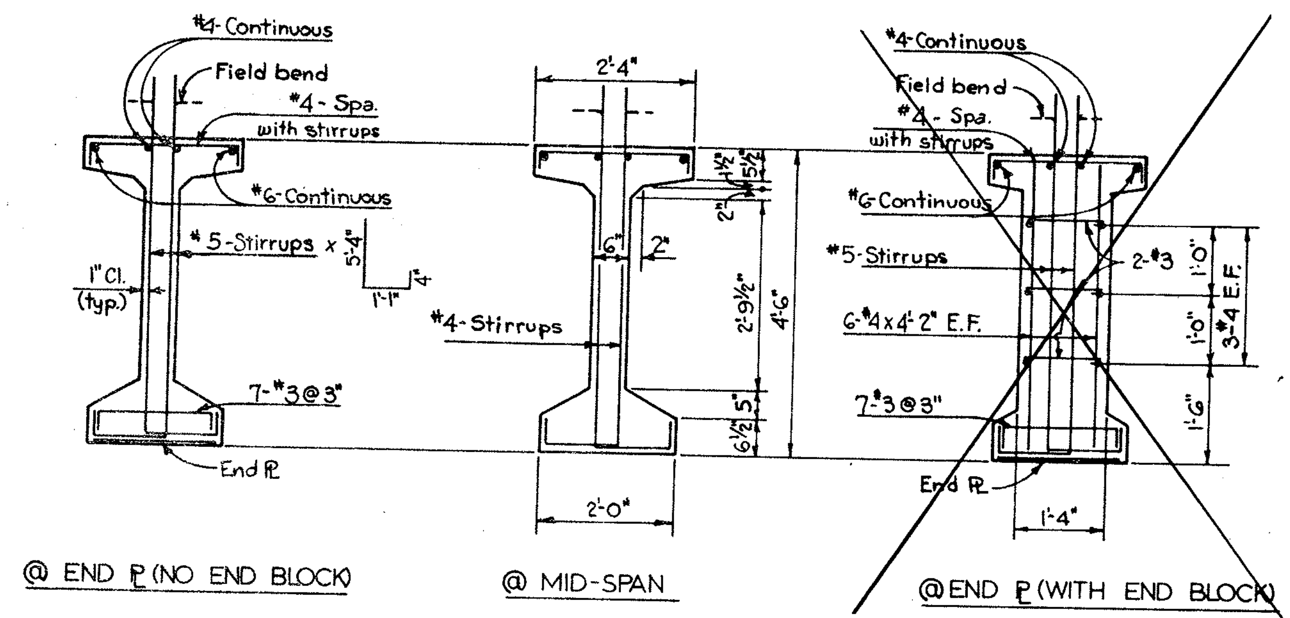
FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	BRS 0330(3)	20	60

REVISIONS			
R1	6-27-74	Replaced Elastomeric Pads with	
		Steel Pls I/A/W C.O.# 05765	RRA



GIRDER ELEVATION (NO END BLOCK)

~~GIRDER ELEVATION (WITH END BLOCK)~~

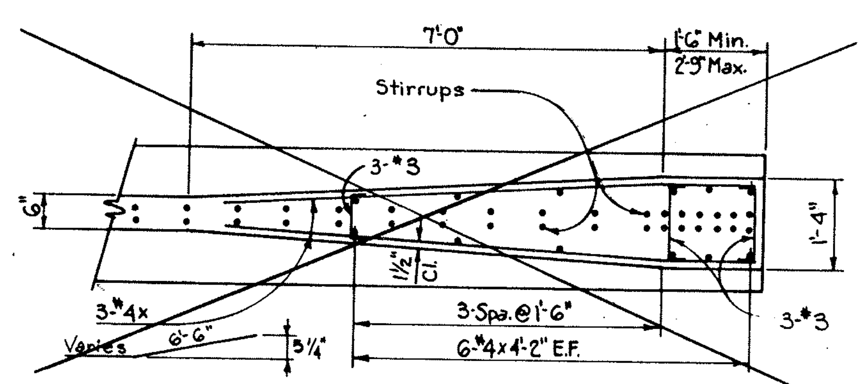


@ END Pl (NO END BLOCK)

@ MID-SPAN

~~@ END Pl (WITH END BLOCK)~~

TYPICAL GIRDER SECTIONS



SECTION (A)

GENERAL NOTES

FABRICATION AND TOLERANCES OF THE PRESTRESSED GIRDERS AND BEARINGS SHALL CONFORM TO THE DIVISION OF HIGHWAYS, STATE OF COLORADO "STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION", "THE LATEST EDITION OF A.A.S.H.O. SPECIFICATIONS", AS AMENDED, AND "STANDARDS FOR PRESTRESSED CONCRETE POLES, SLABS, I-BEAMS AND BOX BEAMS FOR BRIDGES" AS PREPARED BY THE JOINT COMMITTEE OF THE A.A.S.H.O. COMMITTEE ON STRUCTURES AND THE P.C.I.

R1 ALL WORK NECESSARY TO FABRICATE AND INSTALL THE INTEGRAL PARTS OF THE GIRDER (INCLUDING THE 1" ø X 1'-6" THREADED RODS AND STEEL MASONRY PLS.) AS SHOWN ON THE PLANS SHALL BE INCLUDED IN THE BID PRICE FOR ITEM NO. 618, PRESTRESSED CONCRETE UNIT.

ALL ANCHOR BOLTS SHALL BE SNUGGED AND JAMMED EXCEPT AT EXPANSION BEARINGS WHERE THEY SHALL BE SNUGGED AND BACKED OFF ONE FULL TURN BEFORE JAMMING.

A MINIMUM OF TWO HARPING POINTS SHALL BE USED PER GIRDER.

CUT ALL STRANDS FLUSH WITH GIRDER ENDS. THE EXPOSED ENDS OF STRANDS AND A 1" STRIP OF ADJOINING CONCRETE SHALL BE CLEANED AND PAINTED WITH AN APPROVED WATERPROOFING COMPOUND.

USE 1/2" ø STRANDS f's = 270 KSI (STRESS-RELIEVED). ALTERNATE STRANDS ARE LOW-RELAXATION STRANDS MEETING THE REQUIREMENTS OF ASTM-A416-68 GRADE 270.

IF LOW-RELAXATION STRANDS ARE USED THE NET COMPRESSIVE STRESS IN THE CONCRETE AFTER ALL LOSSES SHALL BE AT LEAST AS LARGE AS THAT PROVIDED BY THE STRESS-RELIEVED STRANDS. ALSO, THE ULTIMATE STRENGTH OF THE STRUCTURE WITH THE LOW-RELAXATION STRANDS SHALL MEET THE REQUIREMENTS OF THE APPLICABLE A.A.S.H.O. SPECIFICATIONS.

INTITIAL PRESTRESS FORCE: THE JACKING FORCE PER GIRDER INCLUDING ALL LOSSES.
$F_i = f'_s \times 0.74 \times (A^*_s)$

FINAL PRESTRESS FORCE: THE FORCE REMAINING PER GIRDER AFTER ALL LOSSES
$F_f = f'_s \times 0.52 \times (A^*_s)$

A^*_s = AREA OF PRESTRESSING STEEL

f'_s = ULTIMATE STRENGTH OF PRESTRESSING STEEL

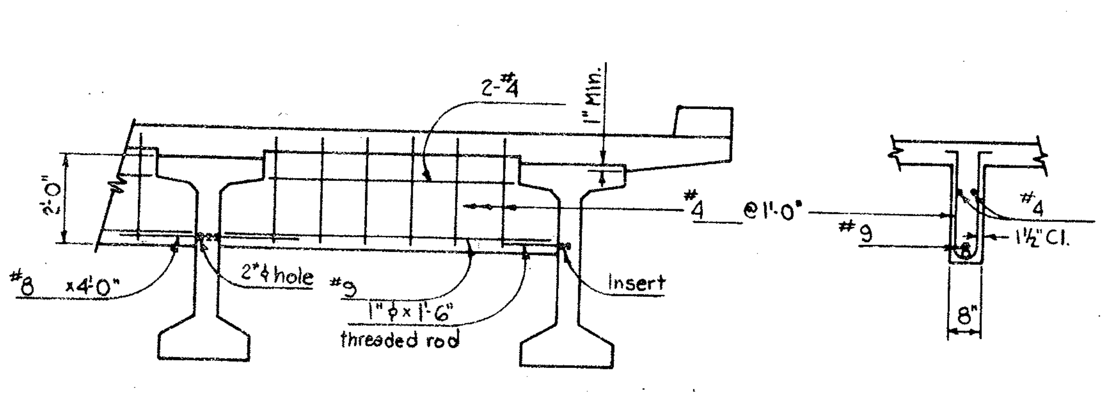
CONCRETE STRENGTH: F'_{ci} IS AT TIME OF RELEASE OF PRESTRESS FORCE. F'_c IS AT 28 DAYS.

CLEARANCE:
1. THE MINIMUM DISTANCE BETWEEN GROUPS OR INDIVIDUAL STRANDS IS 1 3/4" (MEASURED BETWEEN CENTERS OF ADJACENT STRANDS).
2. MINIMUM CONCRETE COVER FOR PRESTRESSING STEEL IS 1-1/2".

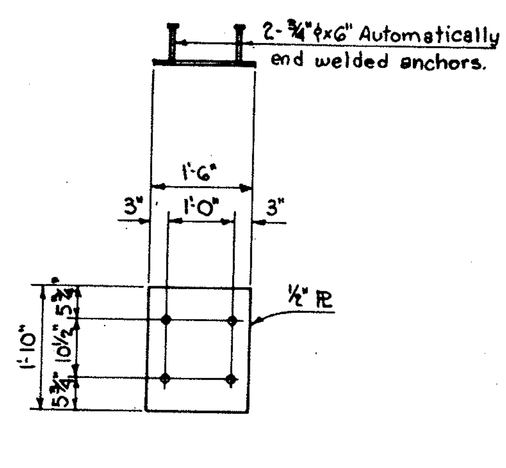
USE 1/2" MINIMUM CHAMFER ON ALL CORNERS.

① FOR DIAPHRAGM LOCATION, SEE SUPERSTRUCTURE PLAN.
② AT END DIAPHRAGMS, 2" DIAMETER HOLES.

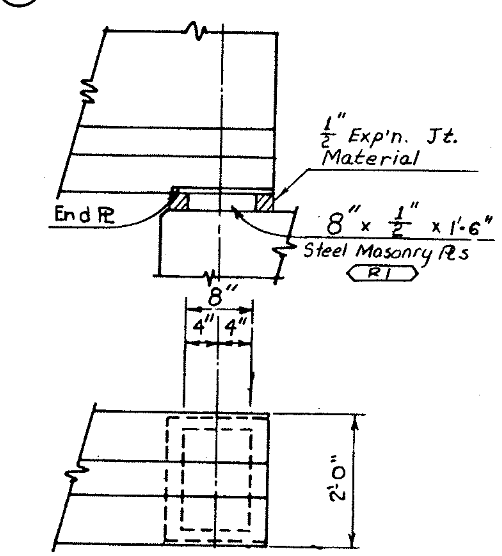
③ AT INTERIOR DIAPHRAGMS, 2" DIAMETER HOLES EXCEPT AT EXTERIOR GIRDERS AND BRIDGES OTHER THAN 90° SKEW, OMIT HOLES AND PLACE INSERTS FOR 1" DIAMETER THREADED RODS.
④ DEFLECTION AT CENTER LINE OF SPAN DUE TO CAST IN PLACE SLAB.



INTERMEDIATE DIAPHRAGM DETAILS



END Pl DETAIL



BEARING DETAIL

GIRDER SCHEDULE

Span No.	Gird. No.	L (Feet)	Ems (Inch)	Ee (Inch)	Fi (KIPS)	Ff (KIPS)	Conc. strength F'ci (PSI)	Conc. strength F'c (PSI)	See Note ④ (Inch)
ALL	ALL	81'-4"	3½	14	796	561	4000	4000	0.73

DIVISION OF HIGHWAYS

COLORADO G54 GIRDER

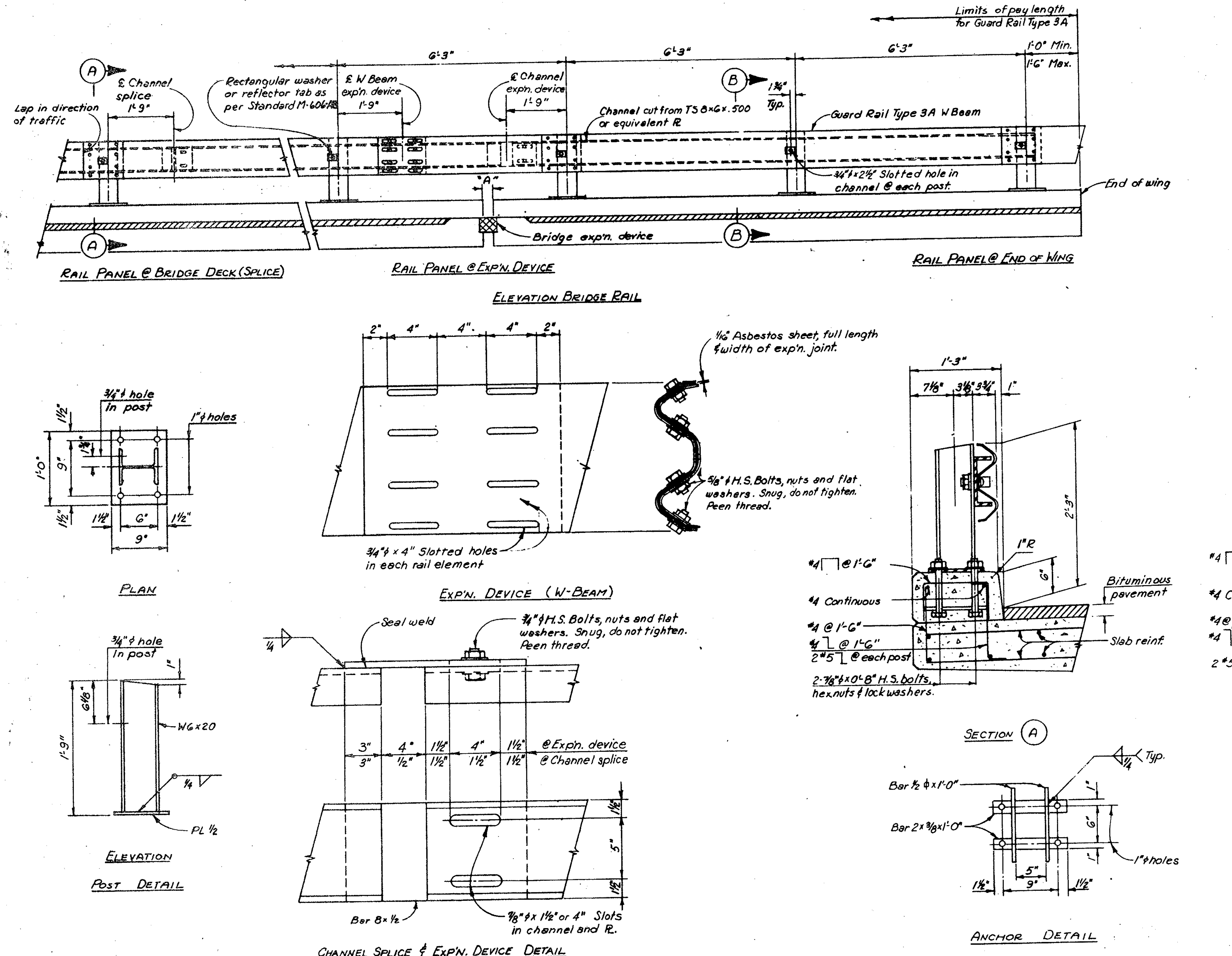
Designer R. AKIN	Structure Numbers	H-4-5
Detailer K. HEATER		
Drawing Number B 12 of 15 Drawings		

53(3-1-73)

AS CONSTRUCTED
NO REVISIONS DATE 1-4-75

FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	BRS 0330(3)	21	60

REVISIONS



NOTES

POSTS SHALL BE PERPENDICULAR TO THE GRADE OF THE DECK.

ALL POSTS, CHANNEL, CHANNEL SPLICE, EXPANSION DEVICE, ANCHOR ASSEMBLY, BOLTS, NUTS AND WASHERS SHALL BE GALVANIZED AFTER FABRICATION IN ACCORDANCE WITH THE SPECIFICATIONS AND SHALL BE MEASURED AND PAID FOR IN ACCORDANCE WITH SECTION 509.

CHANNEL SHALL BE CONTINUOUS OVER NOT LESS THAN TWO (2) POSTS.

POSTS AT EXPANSION JOINT SHALL BE 1'-9" MINIMUM FROM THE CENTER LINE OF THE JOINT TO CENTER LINE OF POST MEASURED ALONG THE CENTER LINE OF POSTS.

ONE OR MORE 6'-3" PANELS MAY BE REDUCED (5'-0" MIN.) IN ORDER TO MAINTAIN DIMENSIONS FROM THE END OF WINGS AND EXPANSION JOINTS.

ALL EXPOSED CORNERS SHALL BE GROUND SMOOTH.

SEE STANDARD M-606-AB FOR ADDITIONAL DETAILS.

The 2'-0" offset between normal edge of shoulder Paving and face of Guard Rail as shown on std. M-606-AB is reduced to 1'-0" for this project.

INITIAL	DATE	CHECKED BY
DESIGNED BY PRA	4-73	BDE 8-73
CHECKED BY JH	8-73	QUANTITIES BY LS 8-73
DETAILED BY JRE	12-73	CHECKED BY BDE 8-73

DIVISION OF HIGHWAYS

BRIDGE RAIL TYPE 3

Designer P.K. PADHIAR
Detailer J.R. EWERT
Structure Numbers H-4-S
Drawing Number B 13 of 15 Drawings

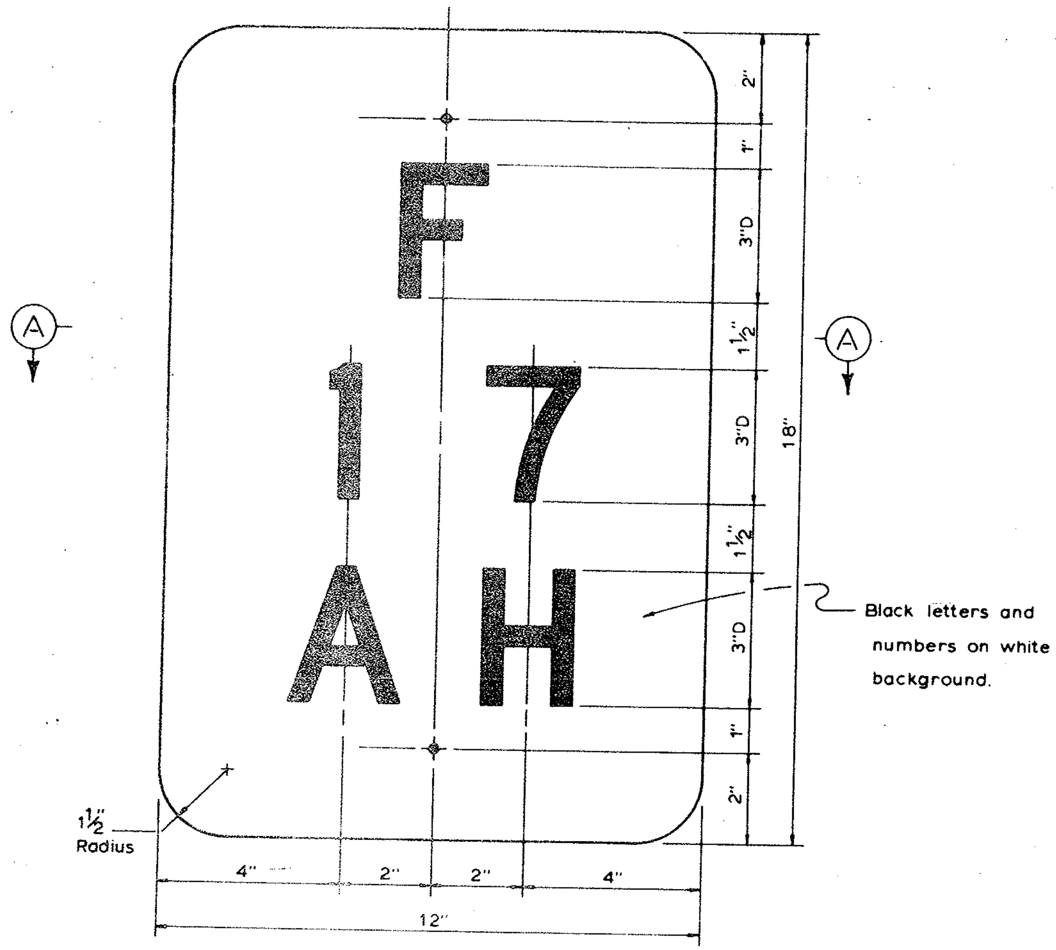
13(12-18-73)

AS CONSTRUCTED
NO REVISIONS DATE 1-4-75

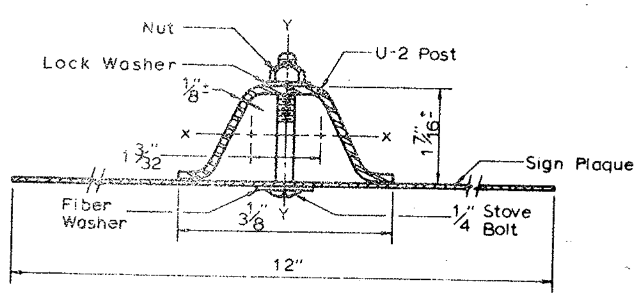
FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	BRS 0330(3)	23	60

REVISIONS

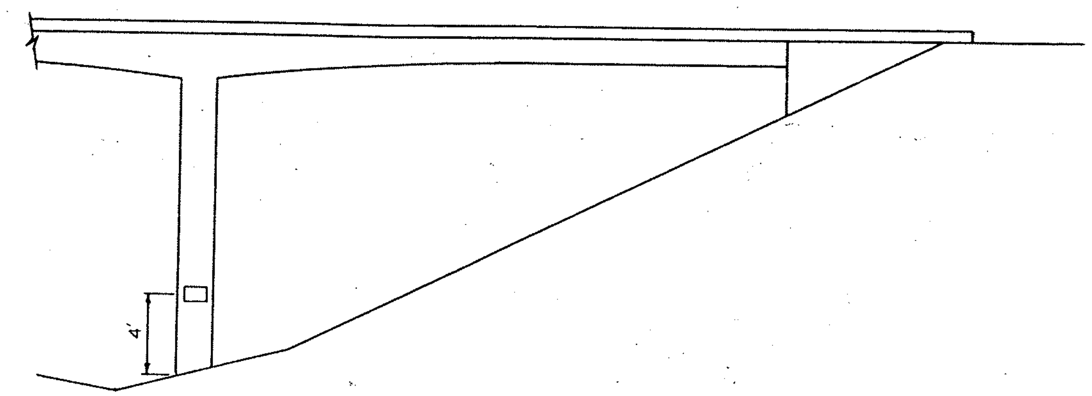
DESIGNED BY	INITIAL	DATE	CHECKED BY	
DESIGNED BY	RHA	4-73	CHECKED BY	L.S. 8-73
CHECKED BY	I.H.	6-73	QUANTITIES BY	
DETAILED BY	BRL	1-72	CHECKED BY	B.E. 8-73



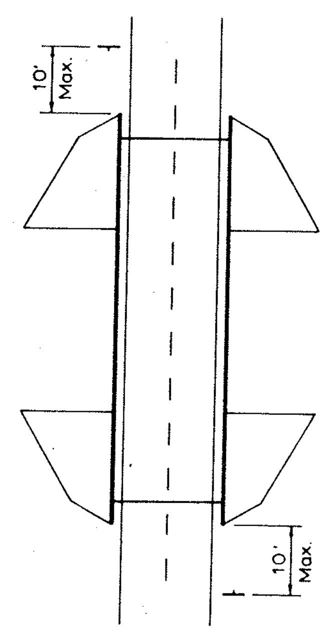
STRUCTURE IDENTIFICATION PANEL
(SAMPLE NUMBERS & LETTERS)



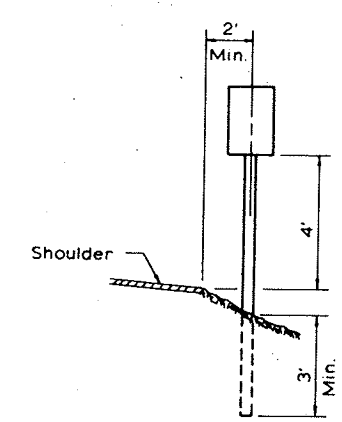
SECTION (A)



STRUCTURE NUMBER LOCATION ON PIERS



(1) STANDARD LOCATION DETAIL



U-2 POST IN GROUND

ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS APPLICABLE TO THE PROJECT.

SIGN PANEL SHALL BE FABRICATED FROM EITHER SHEET STEEL 0.0598 MIN. THICKNESS OR SHEET ALUMINUM 0.060 MIN. THICKNESS.

SIGN PANEL SHALL BE GROUND MOUNTED.

U-2 POST SHALL MEET REQUIREMENTS OF PAR. 4.3 U.S. DEPT. OF COMMERCE, COMMERCIAL STANDARD 184-51. ACCEPTABLE MATERIAL INCLUDES REROLLED RAILROAD RAILS. U-2 POST SHALL WEIGH 2 LBS. PER FT. EXCEPT THAT A MILL TOLERANCE OF MINUS 3-1/2% OF THE WEIGHT OF ANY ONE POST WILL BE ALLOWED. ALTERNATE METAL POST WILL BE ACCEPTABLE IF SECTION MODULUS IS AT LEAST 0.200 $IN.^3$ ABOUT THE X-X AXIS AND AT LEAST 0.250 $IN.^3$ ABOUT THE Y-Y AXIS.

SIGN PANEL SHALL BE FASTENED DIRECTLY TO THE POST WITH TWO 1/4" GALVANIZED OR CADMIUM PLATED STOVE BOLTS. A PLASTIC FIBER WASHER SHALL BE PLACED BETWEEN THE BOLTS HEAD AND THE FACE OF THE PANEL. A GALVANIZED OR CADMIUM PLATED LOCK WASHER SHALL BE PLACED UNDER THE NUT ON THE BACK OF THE POST. EXPOSED BOLT HEADS AND FIBER WASHERS ON THE FACE OF THE SIGN PANEL SHALL BE PAINTED TO MATCH THE SURROUNDING COLOR.

LETTERS AND NUMBERS SHALL BE SERIES "D". THEY SHALL BE 3" HIGH.

THE CORRECT STRUCTURE NUMBER IS SHOWN ON THE PLANS.

(1) OMIT STRUCTURE NUMBER STANDARDS WHERE A RAILROAD TRACK CROSSES OVER THE ROADWAY.

STRUCTURE NUMBER STANDARD SHALL NOT BE PAID FOR SEPARATELY BUT INCLUDED IN THE WORK.

IN ADDITION TO THE REQUIREMENTS STATED ABOVE, STRUCTURE NUMBERS FOR HIGHWAYS PASSING UNDER CROSSROADS ARE TO BE PLACED AT THE FOLLOWING POINTS:

(A) FOR STRUCTURES OF THREE OR MORE SPANS, THE STRUCTURE NUMBER SHALL BE STENCILED, FACING TRAFFIC, ON THE OUTSIDE FACE OF THE END COLUMN OF THE RIGHT HAND PIER.

(B) FOR TWO SPAN STRUCTURES, THE STRUCTURE NUMBER SHALL BE STENCILED, FACING TRAFFIC, ON THE OUTSIDE FACE OF EACH END COLUMN OF THE CENTER PIER.

DIVISION OF HIGHWAYS

STRUCTURE NUMBER STANDARD

Designer	R. AKIN	Structure Numbers	H-4-S
Detailer	L. Sims		
Drawing Number B	15	of 15	Drawings

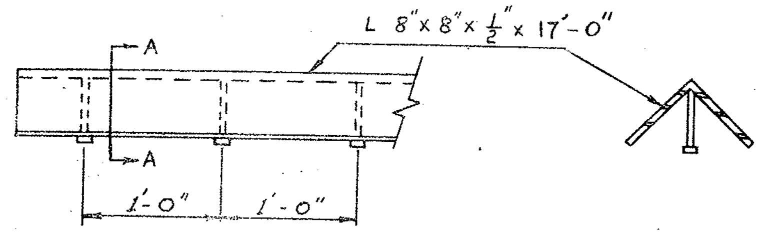
70(2-1-72)

STATE DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS—STATE OF COLORADO

AS CONSTRUCTED
NO REVISIONS DATE 1-4-75

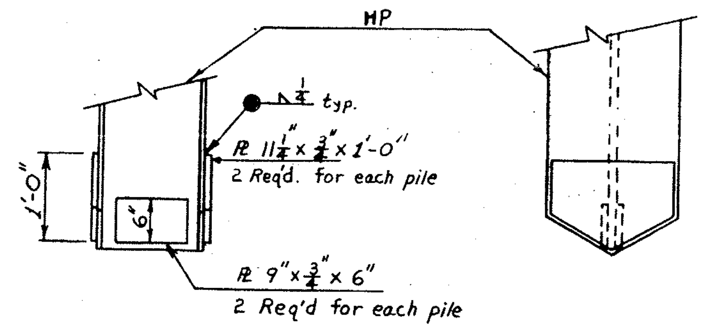
FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	BRS 0330(3)	22	60

REVISIONS

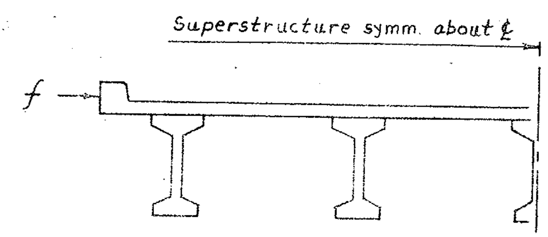


½"ø x 5" Standard anchor stud automatically end welded to angle

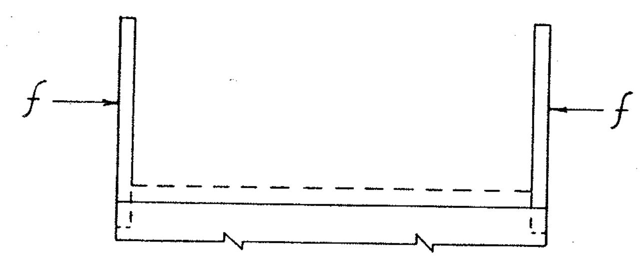
PIER NOSE ANGLE DETAIL



PILE TIP DETAILS



Superstructure



Abutments

CLASS 2 SURFACE FINISH DETAILS

	INITIAL	DATE			
DESIGNED BY	BRA	4-73	CHECKED BY		
CHECKED BY	JH	8-73	QUANTITIES BY	T.S.	8-73
DETAILED BY			CHECKED BY	B.E.	8-73

DIVISION OF HIGHWAYS

MISCELLANEOUS DETAILS

Designer	R. AKIN	Structure Numbers	H-4-S
Detailer	L. Sims		
Drawing Number B 14	of 15	Drawings	

AS CONSTRUCTED
REVISED DATE

FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	S0065(5)	19	

REVISIONS			
R-1	4-10-72	Revised Summary of Quantities	JJW

GENERAL NOTES

ALL WORK SHALL BE DONE ACCORDING TO THE STANDARD SPECIFICATIONS OF THE DIVISION OF HIGHWAYS, STATE OF COLORADO, APPLICABLE TO THE PROJECT.
USE GRADE 60 FOR ALL REINFORCING STEEL, EXCEPT TIES AND STIRRUPS UNLESS OTHERWISE NOTED. ALL TIES AND STIRRUPS ARE GRADE 40.
ALL CONCRETE SURFACES MARKED WITH THE SYMBOL ʄ AS SHOWN ON DRAWING NO. B1 SHALL RECEIVE A CLASS 2 SURFACE FINISH.

ALL CONCRETE CHAMFERS SHALL BE 3/4 INCH UNLESS OTHERWISE NOTED.

EXPANSION JOINT MATERIAL SHALL MEET A.A.S.H.O. SPECIFICATION M 213-65 UNLESS OTHERWISE NOTED.

SOUNDINGS AND DEPTH OF FOOTINGS ARE IN ACCORDANCE WITH THE BEST AVAILABLE DATA. WHEN DIFFERENT CONDITIONS ARE ENCOUNTERED, THE BRIDGE ENGINEER WILL INSPECT AND DETERMINE IF REDESIGN IS NECESSARY.

WHEN TREATED TIMBER PILING IS SHOWN ON THE PLANS, THE PRESERVATIVE FOR TREATMENT SHALL BE CREOSOTE OIL.

WHEN EXCAVATING FOR FOOTINGS, THE FINAL SIX INCHES IN DEPTH SHALL BE DONE BY HAND LABOR METHODS.

FOR DETAILS OF STRUCTURE EXCAVATION AND STRUCTURE BACKFILL, SEE STANDARD M-206-AA.

ALL STRUCTURAL STEEL NOT OTHERWISE NOTED SHALL BE A.A.S.H.O. SPECIFICATION M-183.

ALL STRUCTURAL STEEL NOT OTHERWISE NOTED SHALL BE PAINTED IN ACCORDANCE WITH SECTION 509 FOR (ALUMINUM) PAINT.

ALL BOLTS SHALL BE 3/4" DIAMETER, HIGH STRENGTH, UNLESS OTHERWISE NOTED.

NO WELDING OF ANY KIND SHALL BE PERMITTED ON THE FLANGES OF STEEL GIRDERS UNLESS SPECIFICALLY CALLED FOR IN THE PLANS.

EACH REINFORCING BAR SHALL BE TAGGED WITH BAR DESIGNATION, STRUCTURE NUMBER, AND STATION OF THE PROJECT. THE FIRST DIGIT OR DIGITS: 4-11 OF THE BAR DESIGNATION INDICATES THE BAR SIZE, EXAMPLE: 406 = #4 BAR, 1103 = #11 BAR, ETC. ALL DIMENSIONS ON BAR BENDING DIAGRAMS ARE OUT TO OUT. DIMENSIONS FOR REINFORCING BARS NOT SHOWN AS CLEAR SHALL BE TO THE CENTERLINE OF THE BAR. IF, BY PERMISSION OF THE ENGINEER, PRIMARY BARS ARE SPLICED, THEY SHALL LAP A MINIMUM OF 40 DIAMETERS.

ALL REINFORCING BAR SPLICES SHOWN IN THE SUPERSTRUCTURE SHALL HAVE A MINIMUM LAP OF 40 DIAMETERS UNLESS OTHERWISE NOTED. WHERE SPLICES CONTAIN BARS OF DIFFERENT DIAMETERS, THE SPLICE LENGTH SHALL BE GOVERNED BY THE SMALLEST BAR.

THE FOLLOWING TABLE SHOWS THE MINIMUM 40 DIAMETER LAP FOR COMMON BAR SIZES:

BAR SIZE	#4	#5	#6	#7	#8	#9	#10	#11
LAP	1'-8"	2'-1"	2'-6"	2'-11"	3'-4"	3'-10"	4'-3"	4'-9"

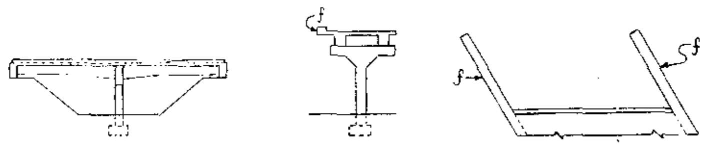
E.F. = EACH FACE
N.F. = NEAR FACE
F.F. = FAR FACE
B.E.I. = BY EQUAL INCREMENTS

SUMMARY OF QUANTITIES

Item	Description	Unit	Super-structure	Abut. 1	Pier 2	Abut. 3	Total
203	Unclassified Excavation	Cu Yd					165
204	Haul	Ton Mi	130				130
206	Structure Excavation	Cu Yd		180	135	365	680
206	Structure Backfill (Class 2)	Cu Yd		35	88	35	158
403	Hot Bituminous Pavement (Grading Dx)	Ton	62				62
411	Asphalt Cement (AC 5)	Ton	5				5
502	Steel Piling (14BP89)	Lin.Ft.		108	128	168	404
502	Reinforcing Tip	Each		6	8	6	20
506	Heavy Riprap	Cu Yd		551		1194	1745
509	Structural Steel	Lb			455		455
509	Structural Steel (Galvanized)	Lb.	11,740				11,740
515	Waterproofing (Membrane)	Sq.Yd.	790				790
601	Concrete Class A (Bridge)	Cu.Yd.		27.4	98.2	27.4	153.0
601	Concrete Class D (Bridge)	Cu Yd.	321	18		18	357
602	Reinforcing Steel	Lbs.	111,702	4441	9386	4441	129,970 (R-1)
* 613	3 Inch Electrical Conduit (Plastic)	Lin.Ft.	334				334
626	Mobilization	L.S.					0.15

* All work to be done by contractor. (Non-federal-aid) Mountain Bell shall reimburse the Department for this work.

INDEX OF DRAWINGS



SURFACE FINISH DETAILS

BRIDGE DESCRIPTION

2-Spans (62'-0", 62'-0") Continuous Parabolic Concrete T-Beam Bridge.

Over Plateau Creek
56'-0" Roadway Curb to Curb 60°-0' skew
1'-3" curbs, Bridge Rail Type 1

LOADING DATA

LIVELOAD: A.A.S.H.O. HS-20-44 OR INTERSTATE ALTERNATE.
DEADLOAD: ASSUMES 20 LBS. PER SQ. FT. ADDITIONAL WEARING SURFACE. NO PROVISION HAS BEEN MADE FOR ADDITIONAL OVERLAYS.

DESIGN DATA

A.A.S.H.O. UNIT STRESSES, EXCEPT AS NOTED.

REINFORCING STEEL:		Fs = 20,000 LBS. PER SQ. IN.
	FOR TRANSVERSE BARS IN ROADWAY SLAB ONLY.	Fs = 24,000 LBS. PER SQ. IN.
STRUCTURAL STEEL:	A36	Fs = 20,000 LBS. PER SQ. IN.
	A572, GRADE 50	Fs = 27,000 LBS. PER SQ. IN.
CONCRETE:		Fc = 1,200 LBS. PER SQ. IN.
		n = 10

Approved
P.E. 3/29/72
Bridge Engineer Date

DIVISION OF HIGHWAYS

GENERAL INFORMATION
SUMMARY OF QUANTITIES

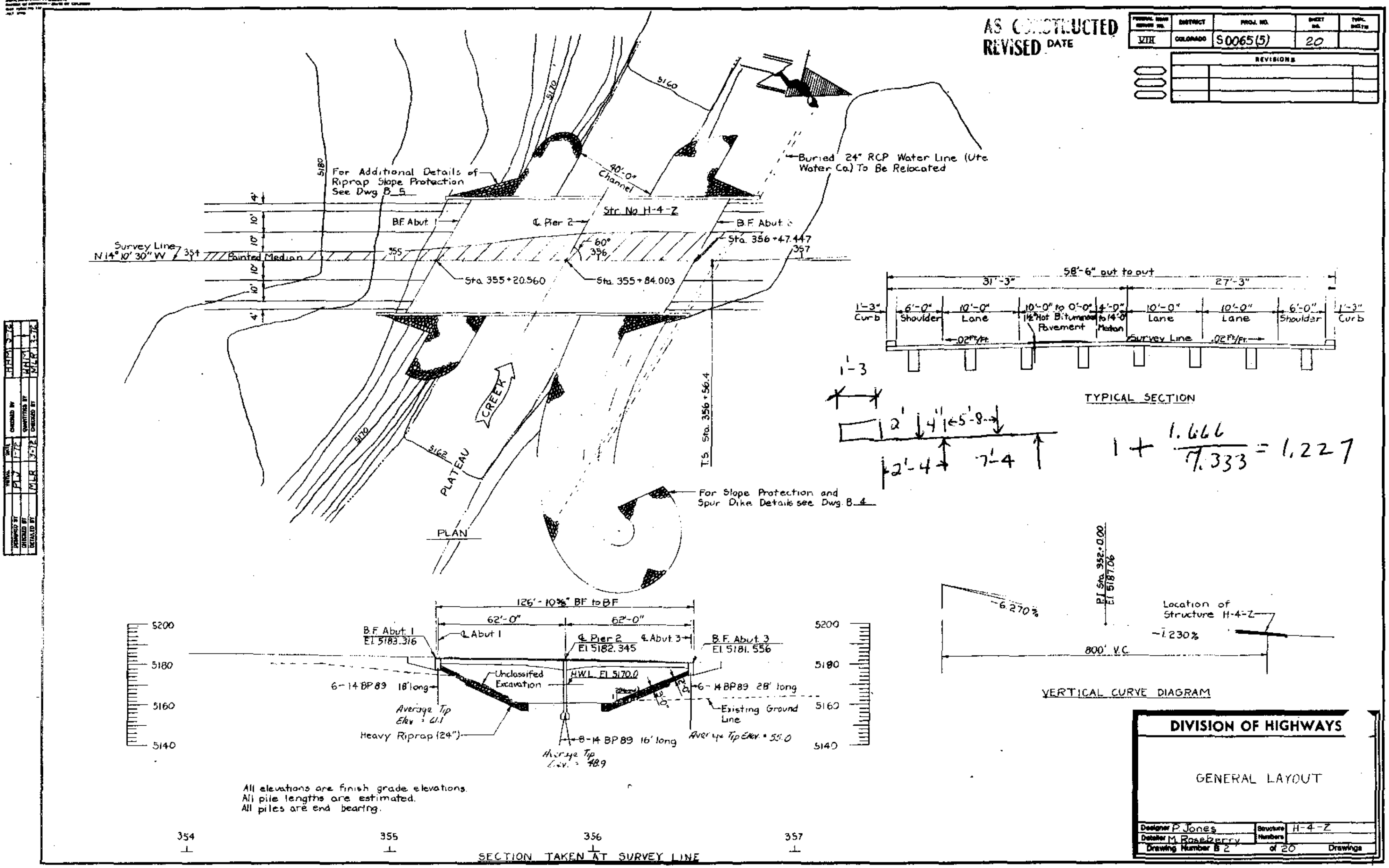
Station 355+20.560 to 356+47.447
Station

Near Mesa Sec 18 T 10S. R 96 W.

Designer P. Jones | Structure Numbers H-4-Z
Detailer Mays

Drawing Number B 1 of 20 Drawings.

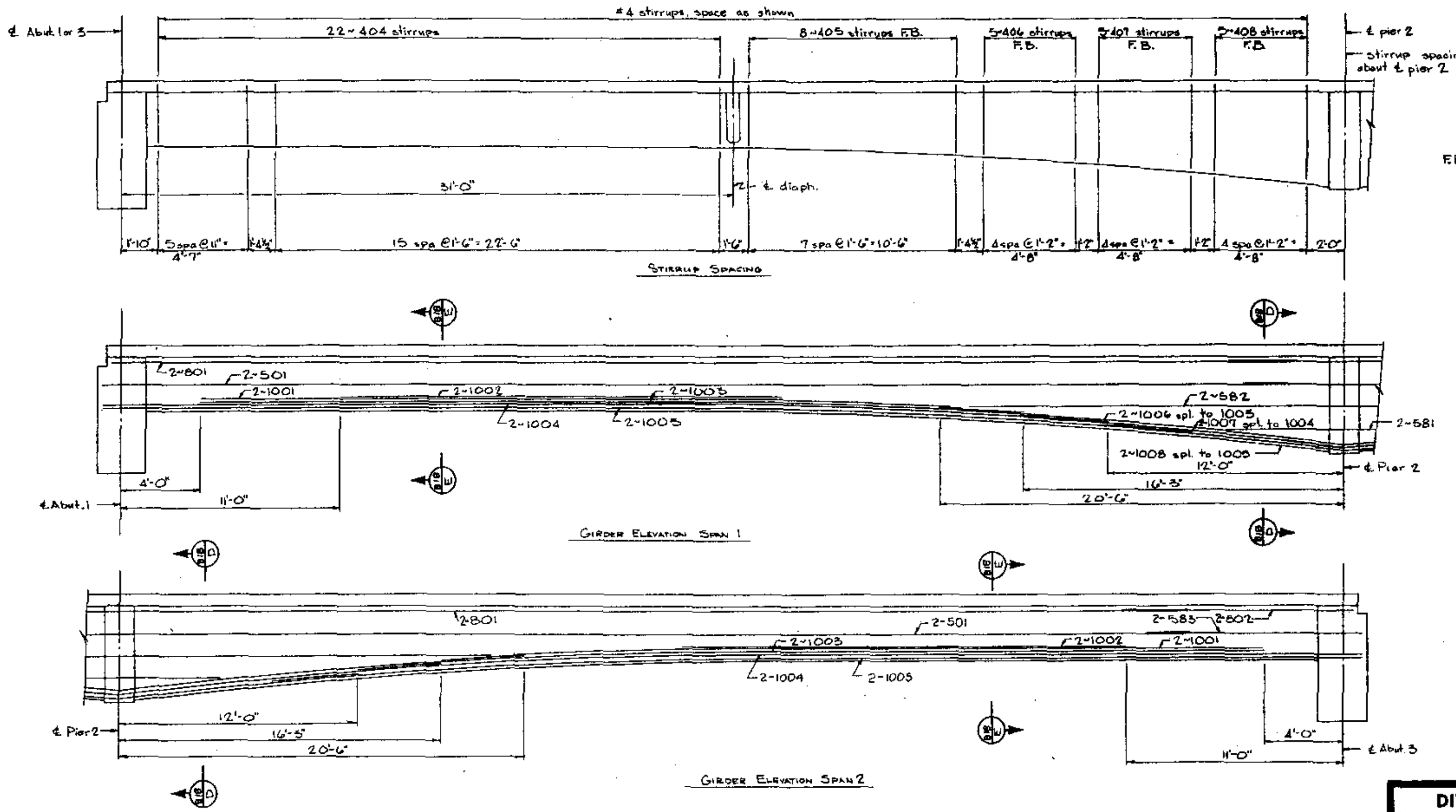
O(7-1-71)



$$
\begin{array}{r}
28' \\
-\ 25.66 \\
\hline
2.334'
\end{array}
$$

FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	S0065(5)	35	

REVISIONS			
R-1	4-10-72	Added Note	T.D.B.

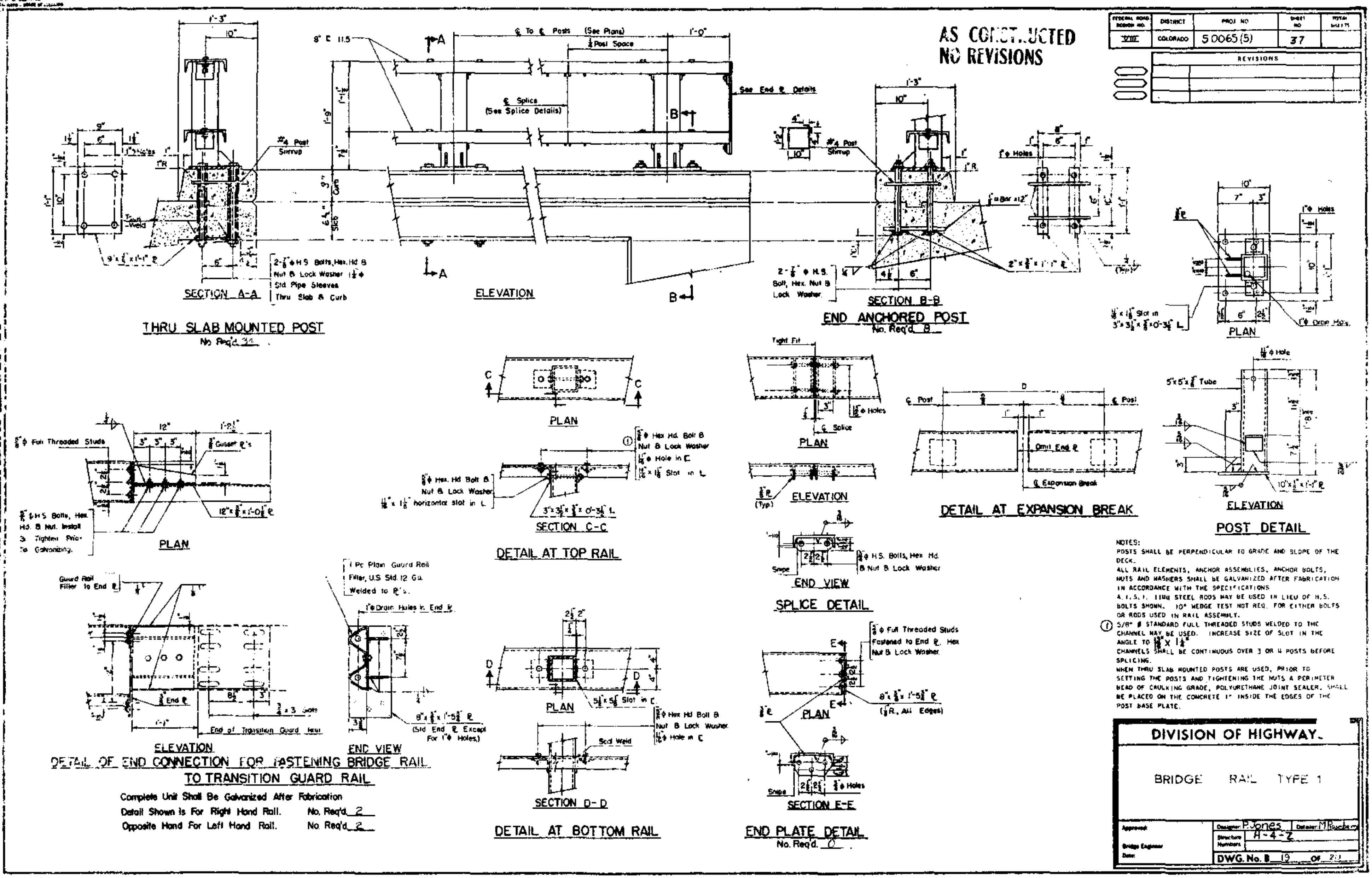


INITIAL	DATE	
P.J.	1-72	DESIGNED BY
		CHECKED BY
T.D.B.	2-72	DETAILED BY
		CHECKED BY
		QUANTITIES BY
		CHECKED BY

DIVISION OF HIGHWAYS

GIRDER REINFORCING

Designer P. Jones | Structure Numbers H-4-2
Detailer T. Breder
Drawing Number B 17 of 20 Drawings



AS CONSTRUCTED
NO REVISIONS
FEDERAL ROAD REGION NO. VIII
DISTRICT COLORADO
PROJ. NO. S 0065 (5)
SHEET NO. 37
REVISIONS
THRU SLAB MOUNTED POST
No Req'd 34
SECTION A-A
ELEVATION
SECTION B-B
END ANCHORED POST
No. Req'd 8
PLAN
ELEVATION
POST DETAIL
DETAIL AT TOP RAIL
SECTION C-C
SPLICE DETAIL
END VIEW
DETAIL AT EXPANSION BREAK
DETAIL OF END CONNECTION FOR FASTENING BRIDGE RAIL TO TRANSITION GUARD RAIL
Complete Unit Shall Be Galvanized After Fabrication
Detail Shown Is For Right Hand Rail. No. Req'd 2
Opposite Hand For Left Hand Rail. No. Req'd 2
DETAIL AT BOTTOM RAIL
SECTION D-D
END PLATE DETAIL
No. Req'd 0
SECTION E-E
NOTES:
POSTS SHALL BE PERPENDICULAR TO GRADE AND SLOPE OF THE DECK.
ALL RAIL ELEMENTS, ANCHOR ASSEMBLIES, ANCHOR BOLTS, NUTS AND WASHERS SHALL BE GALVANIZED AFTER FABRICATION IN ACCORDANCE WITH THE SPECIFICATIONS.
A.I.S.I. 1144 STEEL RODS MAY BE USED IN LIEU OF H.S. BOLTS SHOWN. 10° WEDGE TEST NOT REQ. FOR EITHER BOLTS OR RODS USED IN RAIL ASSEMBLY.
(1) 5/8" ⌀ STANDARD FULL THREADED STUDS WELDED TO THE CHANNEL MAY BE USED. INCREASE SIZE OF SLOT IN THE ANGLE TO 13/16" X 1 1/4"
CHANNELS SHALL BE CONTINUOUS OVER 3 OR 4 POSTS BEFORE SPLICING.
WHEN THRU SLAB MOUNTED POSTS ARE USED, PRIOR TO SETTING THE POSTS AND TIGHTENING THE NUTS A PERIMETER BEAD OF CAULKING GRADE, POLYURETHANE JOINT SEALER, SHALL BE PLACED ON THE CONCRETE 1" INSIDE THE EDGES OF THE POST BASE PLATE.
DIVISION OF HIGHWAYS
BRIDGE RAIL TYPE 1
Designer P. Jones
Detailer M.R.
Structure Numbers H-4-Z
DWG. No. B 19 OF 20

10 (9-1-71)

GENERAL [illegible]OTES: Sheet 25

SPECIFICATIONS: Construction, Federal Highway Administration FP-[illegible] Design AASHTO Standard Specifications for Highway Bridges, 1973, with 1974 and 1975 Interim Specifications.

DEAD LOAD: Concrete, 150 lbs. per cu. ft., paving allowance, 25 lbs. per sq. ft. of roadway surface, earth pressure equivalent to a fluid weighing 36 lbs. per cu. ft.

LIVE LOAD: HS20-44 Loading. Impact I = 50/(L+125) (L = Span Length). Maximum I = 30%.

UNIT STRESSES: Allowable stress in Class A(AE) concrete: f'c = 1320 psi based on an assumed 28 day design strength of 3300 psi except for slab design where f'c = 1200 psi. Allowable stress in reinforcing steel: fs = 20,000 psi. Modular Ratio n = 10.

CONCRETE: All concrete shall be Class A(AE). All concrete shall be mixed with an approved air entraining admixture and shall be vibrated. Chamfer exposed edges 3/4" unless otherwise shown. No admixture containing calcium chloride shall be used. Cement shall be Type II, low alkali.

FINISHING CONCRETE: The roadway slab and curb shall be given a "Float Finish". The following surfaces shall be given a "Class 2 Finish": outside faces of the roadway slab, both faces of the curbs, exterior faces of exterior girders, and exposed faces of end wings to one foot below finished ground line. All other concrete surfaces shall be given a "Class 1 Finish".

REINFORCING STEEL: All conventional reinforcing steel shall conform to AASHTO M31, Grade 40 [illegible] (Grade 40). The minimum concrete covering to the face of any bar shall be 2" unless otherwise shown on the plans. Minimum splice lengths for all bar sizes shall be as shown on the plans. Bar splices other than those shown on the plans will not be paid for and must be approved by the Engineer.

STEEL BRIDGE RAILING: Steel bridge railing shall conform to the plans and specifications.

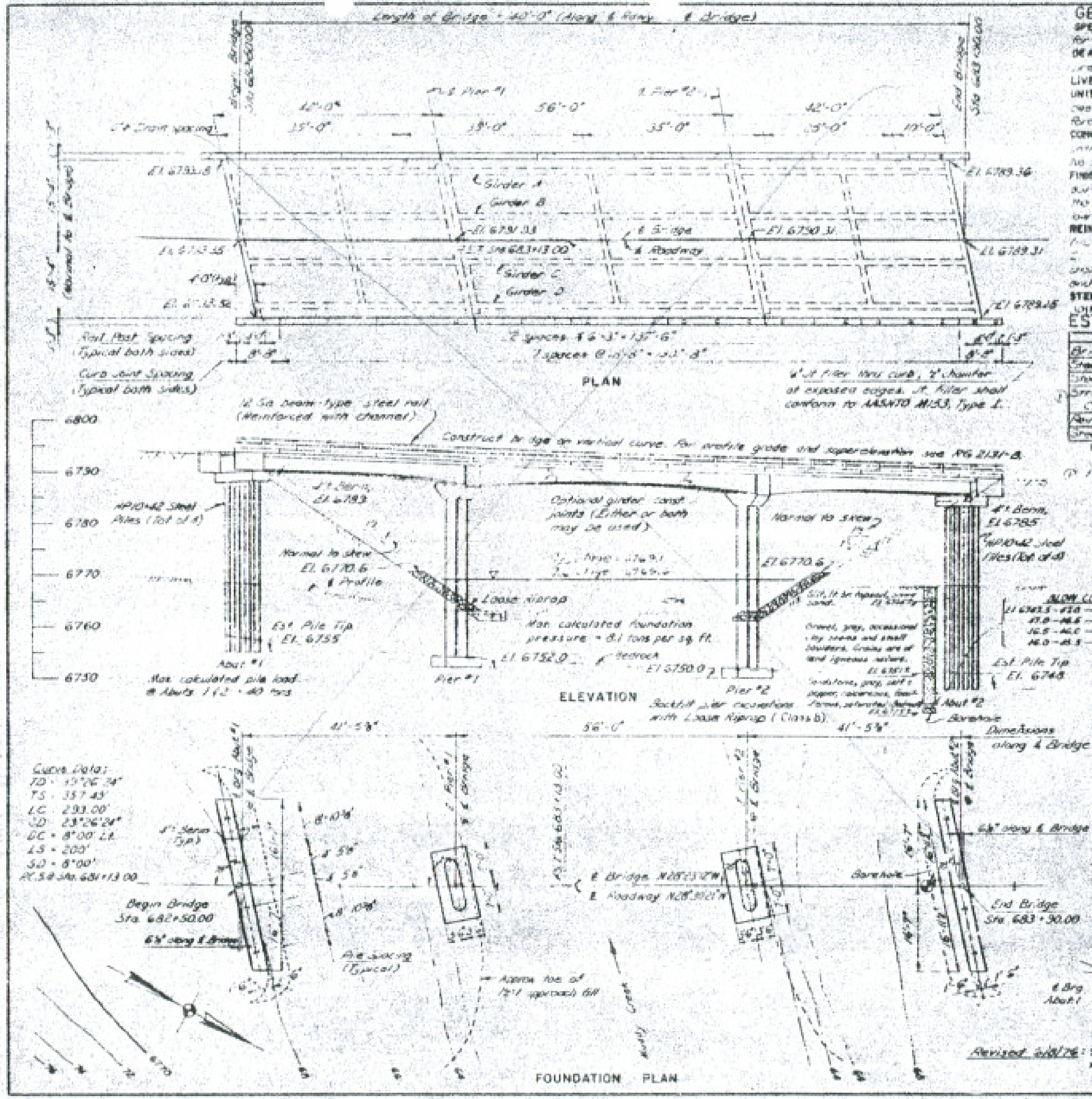
JOINT MATERIAL: Preformed joint filler shall conform to AASHTO M153.

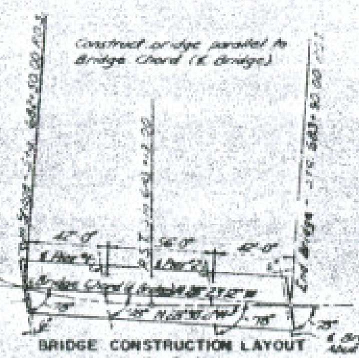
ESTIMATE:

Item	Unit	Superstr.	Abut 1	Pier 1	Pier 2	Abut 2	Total
Bridge Excavation	Cu. Yds.			80	90		170
Steel H-Piles, Furnished	Lin. Ft.		135			147	282
Steel H-Piles, Driven	Each		4			4	8
Structural Concrete Class A(AE)	Cu. Yds.	235.4	7.5	34.3	34.6	7.5	319.3
Reinforcing Steel	Pound	*64,686	1176	12,173	12,173	1176	*91,384
Steel Bridge Railing	Lin. Ft.	231					231

* Includes weight of guard angles and deck drains. Quantity shown is based on no optional girder const. joints being used.

(P) Final Quantity





BRIDGE NUMBER: H-7-I

DESIGNED BY FEDERAL HWY ADMINISTRATION REGION 8 DENVER, COLORADO OFFICE OF WESTERN BRIDGE DESIGN

APPROVED [signature] DIRECTOR

U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION REGION 8 DENVER, COLORADO

BRIDGE OVER MUDDY CREEK

STA. 683+21

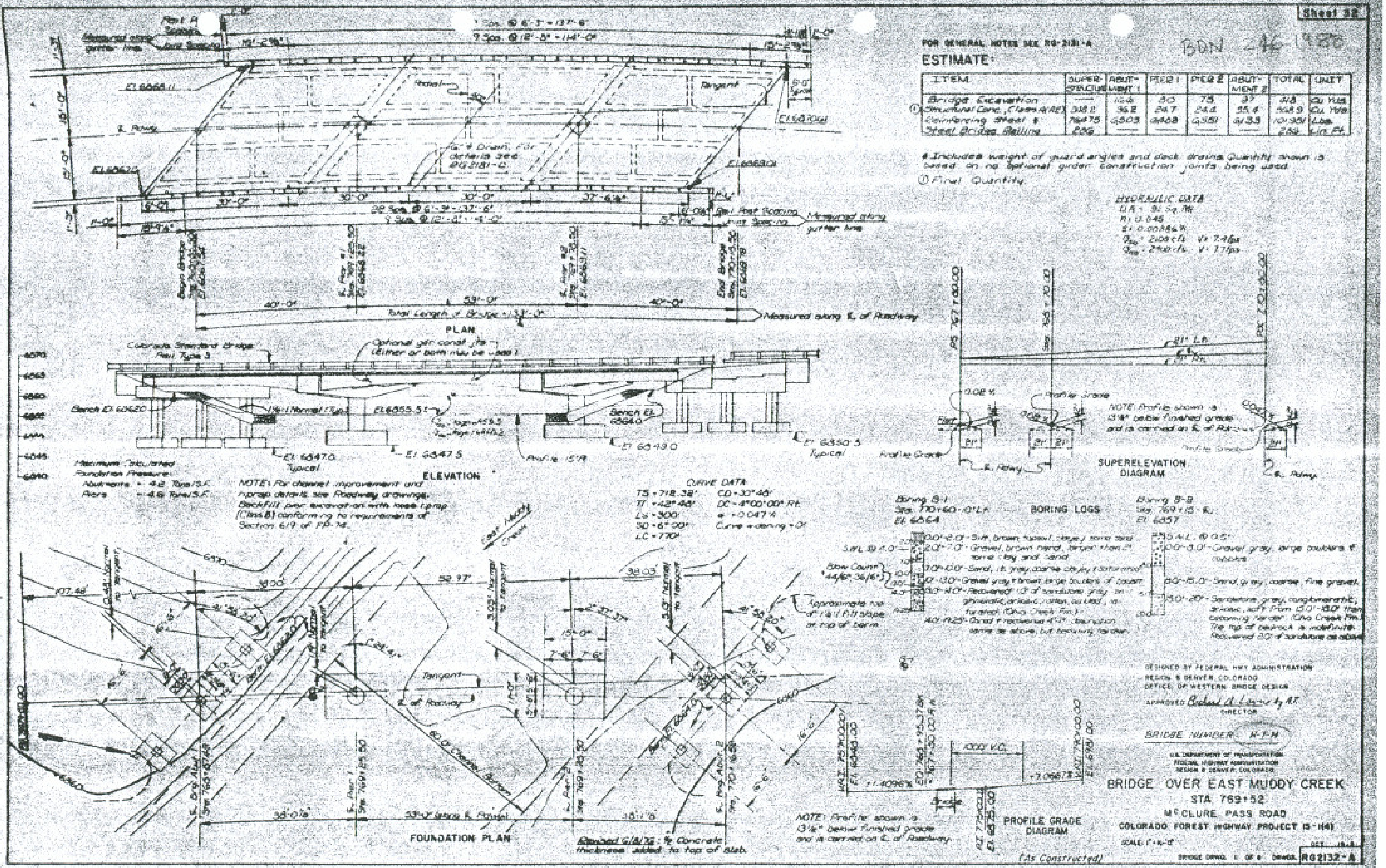
McCLURE PASS ROAD

COLORADO FOREST HIGHWAY PROJECT 15-1(4)

SCALE: 1" = 10'-0"

(As Constructed)

BRIDGE DRWG. 1 OF 7 DRWG. RG 2131-A



FOR GENERAL NOTES SEE RG-2131-A

BDN 246-1980

ESTIMATE:

ITEM	SUPER-STRUCTURE	ABUT-MENT 1	PIER 1	PIER 2	ABUT-MENT 2	TOTAL	UNIT
Bridge Excavation	—	164	80	75	97	418	Cu. Yds.
① Structural Conc. (Class A(AE))	318.2	36.2	24.7	24.4	35.4	438.9	Cu. Yds.
Reinforcing Steel *	76475	6303	6468	6381	6133	101,981	Lbs.
Steel Bridge Railing	286	—	—	—	—	286	Lin. Ft.

* Includes weight of guard angles and deck drains. Quantity shown is based on no optional girder construction joints being used.

① Final Quantity.

DESIGNED BY FEDERAL HWY ADMINISTRATION
REGION 9 DENVER, COLORADO
OFFICE OF WESTERN BRIDGE DESIGN

APPROVED Richard A. Lazar by A.T.
DIRECTOR

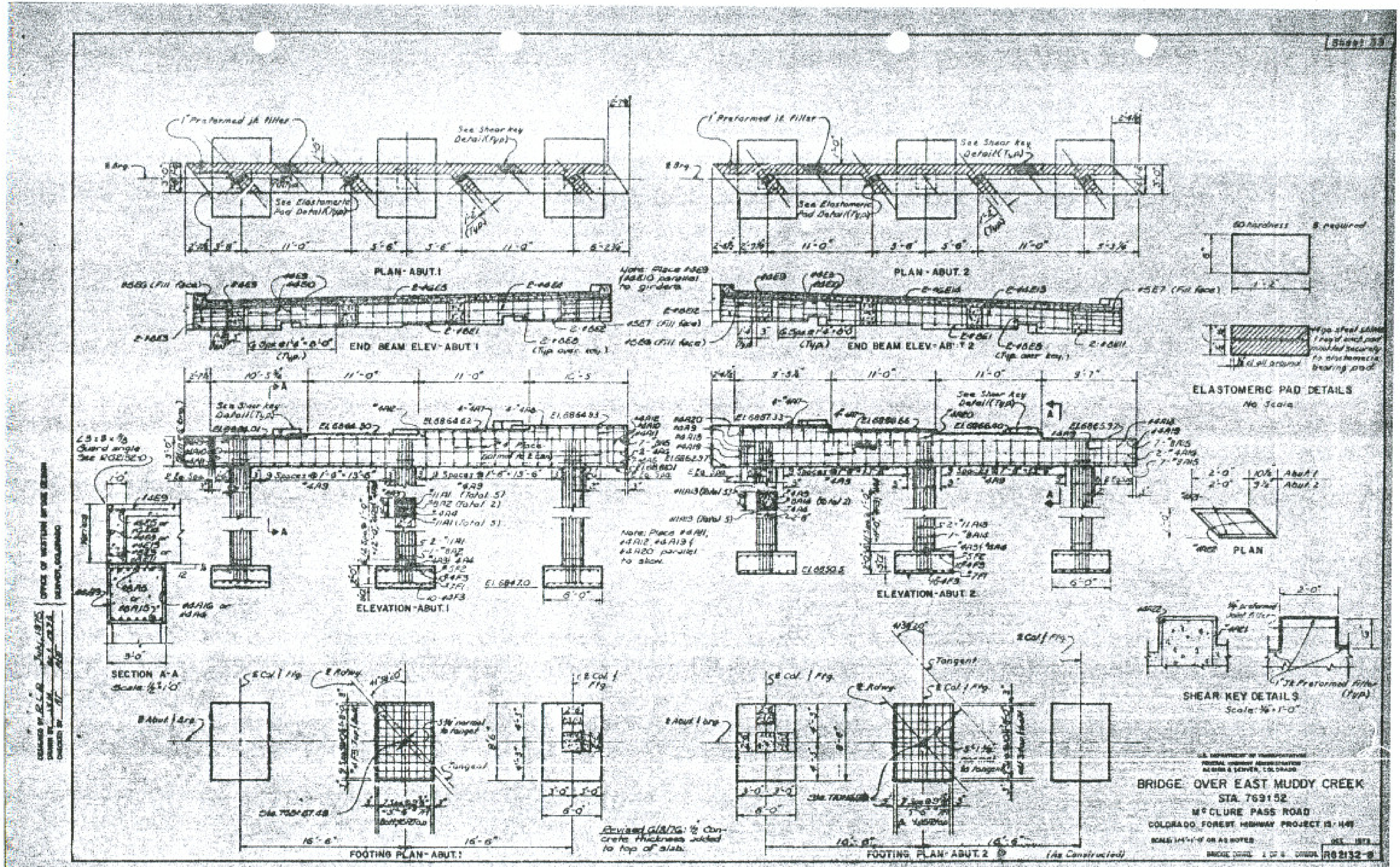
BRIDGE NUMBER H-1-H

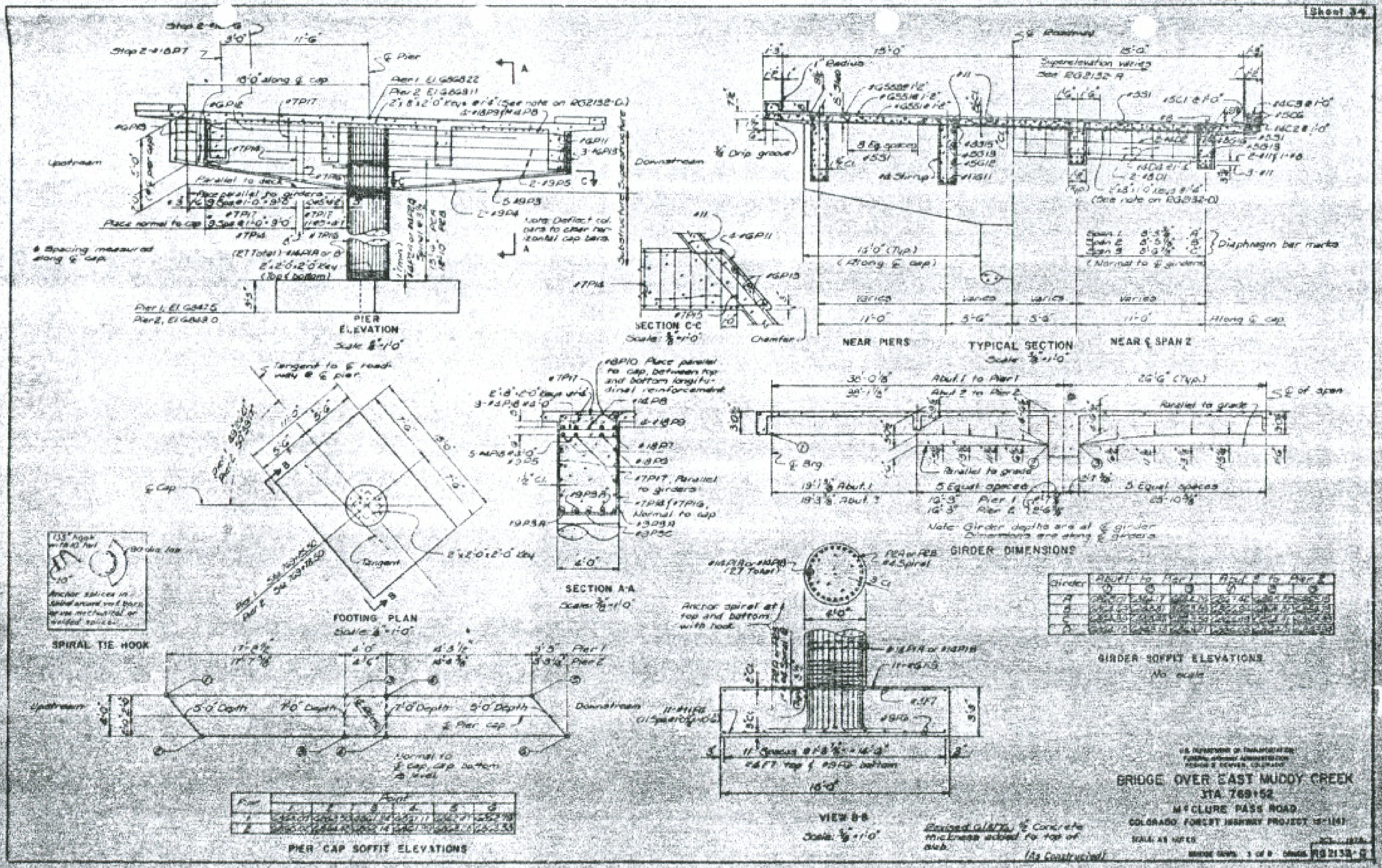
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
REGION 9 DENVER, COLORADO

BRIDGE OVER EAST MUDDY CREEK
STA 769+52
McCLURE PASS ROAD
COLORADO FOREST HIGHWAY PROJECT 15-1(4)

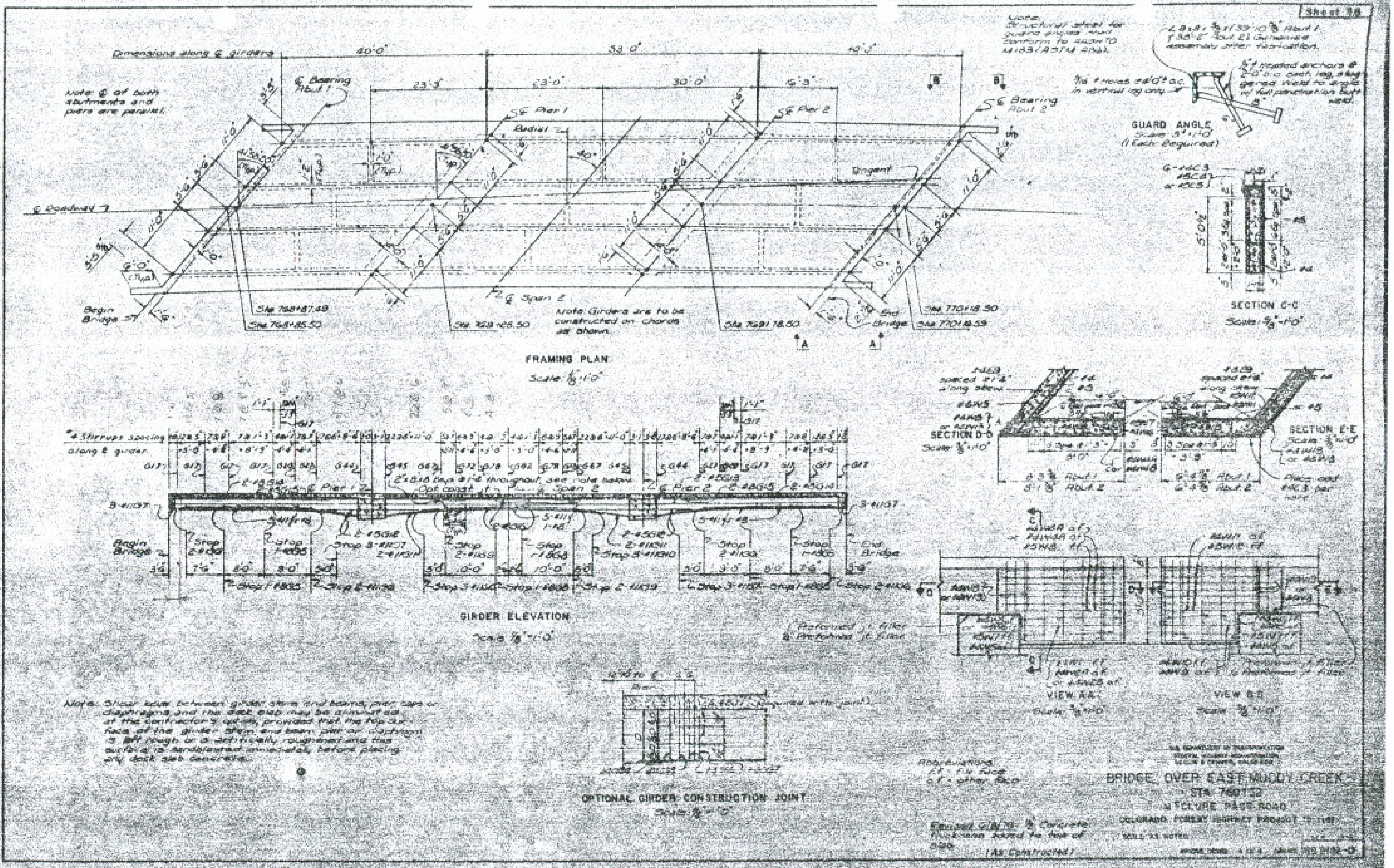
SCALE 1" = 10'-0"

BRIDGE DRWG. 1 OF 8 DRWG. RG2132-A

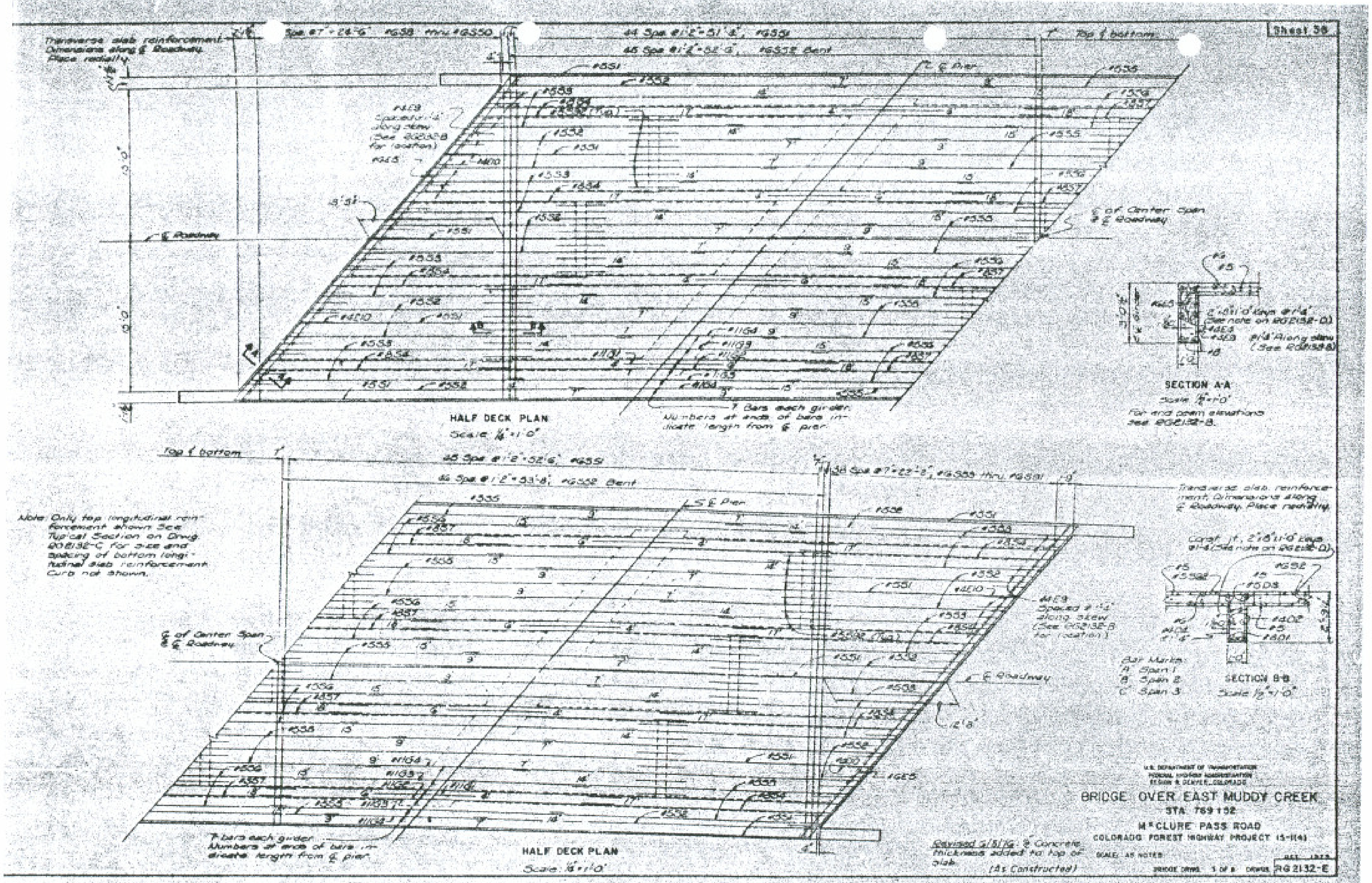

PLAN - ABUT. 1
PLAN - ABUT. 2
END BEAM ELEV - ABUT 1
END BEAM ELEV - ABUT 2
ELASTOMERIC PAD DETAILS
No Scale
ELEVATION - ABUT. 1
ELEVATION - ABUT. 2
SECTION A-A
PLAN
SHEAR KEY DETAILS
FOOTING PLAN - ABUT. 1
FOOTING PLAN - ABUT. 2
(As Constructed)
BRIDGE OVER EAST MUDDY CREEK
STA. 769152
M^c CLURE PASS ROAD
R62132-6

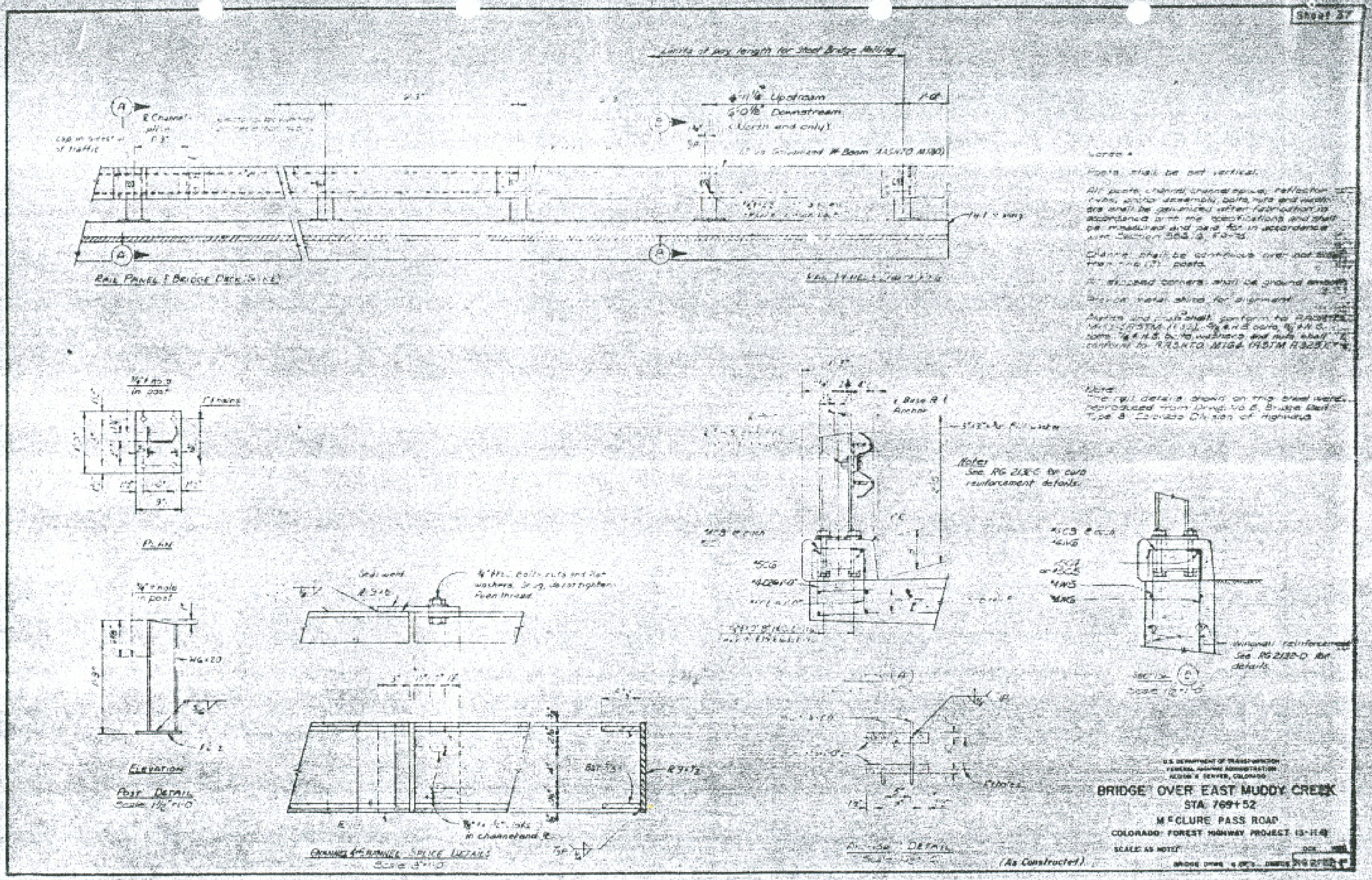


Sheet 34
PIER ELEVATION
Scale 3/8"=1'-0"
SECTION C-C
TYPICAL SECTION
NEAR PIERS
NEAR ℄ SPAN 2
FOOTING PLAN
SECTION A-A
GIRDER DIMENSIONS
GIRDER SOFFIT ELEVATIONS
No scale
SPIRAL TIE HOOK
PIER CAP SOFFIT ELEVATIONS
VIEW B-B
Upstream
Downstream
(As Constructed)
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
DENVER, COLORADO
BRIDGE OVER EAST MUDDY CREEK
STA 769+52
McCLURE PASS ROAD
COLORADO FOREST HIGHWAY PROJECT 13-1(4)
SCALE: AS NOTED
RG2132-G



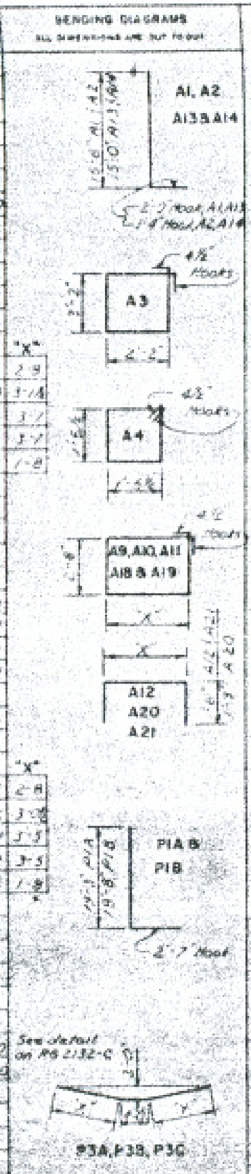
Sheet 38
Dimensions along ℄ girders
40'-0"
53'-0"
49'-0"
Note: ℄ of both abutments and piers are parallel.
℄ Bearing Abut 1
℄ Pier 1
℄ Pier 2
℄ Bearing Abut 2
℄ Roadway
Tangent
Radial
℄ Span 2
Begin Bridge
End Bridge
Sta 768+87.49
Sta 768+85.50
Sta 769+25.50
Sta 769+78.50
Sta 770+18.50
Sta 770+18.59
Note: Girders are to be constructed on chords as shown.
FRAMING PLAN
Scale: 1/8"=1'-0"
GUARD ANGLE
(1 Each Required)
SECTION C-C
SECTION D-D
SECTION E-E
GIRDER ELEVATION
Scale 1/8"=1'-0"
VIEW A-A
VIEW B-B
Preformed Jt. Filler
OPTIONAL GIRDER CONSTRUCTION JOINT
Abbreviations
f.f. - f.f. face
o.f. - other face
(As Constructed)
BRIDGE OVER EAST MUDDY CREEK
STA. 769+52
McCLURE PASS ROAD
COLORADO FOREST HIGHWAY PROJECT
OFFICE OF WESTERN BRIDGE DESIGN
DENVER, COLORADO


Sheet 38
Transverse slab reinforcement. Dimensions along ℄ Roadway. Place radially.
Top & bottom
℄ Pier
℄ Roadway
℄ of Center Span & ℄ Roadway
HALF DECK PLAN
Scale: 1/4"=1'-0"
7 Bars each girder. Numbers at ends of bars indicate length from ℄ pier.
SECTION A-A
Scale 1/2"=1'-0"
For end beam elevations see RG2132-B.
Note: Only top longitudinal reinforcement shown. See Typical Section on Drwg. RG2132-C for size and spacing of bottom longitudinal slab reinforcement. Curb not shown.
Bar Marks:
A Span 1
B Span 2
C Span 3
SECTION B-B
Scale 1/2"=1'-0"
HALF DECK PLAN
Scale: 1/4"=1'-0"
7 bars each girder. Numbers at ends of bars indicate length from ℄ pier.
Revised 6/8/76 ... Concrete thickness added to top of slab.
(As Constructed)
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
REGION 9 DENVER, COLORADO
BRIDGE OVER EAST MUDDY CREEK
STA. 769+52
McCLURE PASS ROAD
COLORADO FOREST HIGHWAY PROJECT 15-1(4)
SCALE: AS NOTED
BRIDGE DRWG. 5 OF 8 DRWG. RG 2132-E

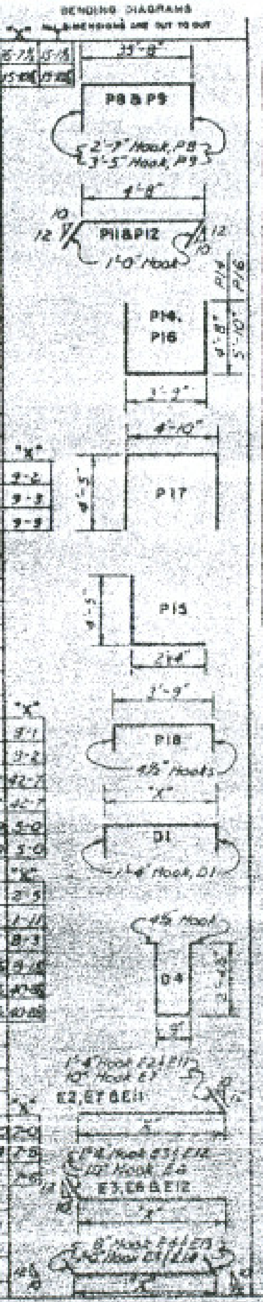

Sheet 37
Limits of pay length for Steel Bridge Railing
Upstream
Downstream
(North end only)
Galvanized W Beam AASHTO M180
RAIL PANEL & BRIDGE DECK SPLICE
PLAN
ELEVATION
POST DETAIL
Notes:
See RG 2138-C for curb reinforcement details.
Wingwall reinforcement See RG 2138-D for details
in channel and
ANCHOR DETAIL
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
BRIDGE OVER EAST MUDDY CREEK
STA. 769+52
McCLURE PASS ROAD
COLORADO FOREST HIGHWAY PROJECT
SCALE: AS NOTED
(As Constructed)

Sheet 30

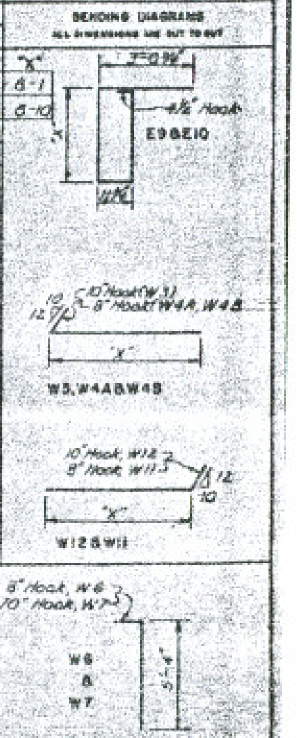
LOCATION	STRAIGHT BARS MARK	NO.	SIZE	LENGTH	BENT BARS MARK	NO.	SIZE	LENGTH	"X"
SUBSTRUCTURE									
Abutment 1									
Footing-Longit-Bott	F1	24	7	8-2					
" " " -Top	F2	24	5	8-2					
" -Transv.	F3	60	4	5-8					
Column-Vert					A1	30	11	18-6	
" "					A2	6	8	17-10	
" Ties					A3	39	4	9-5	
" "					A4	39	4	6-11	
Cap-Horiz.	A5	14	8	42-7					
" "	A6	2	4	42-7					
" "	A7	4	4	12-0					
" "	A8	4	4	10-1					
" Tie					A9	24	4	11-5	2-9
" " Ends					A10	2	4	12-4	3-1½
" " "					A11	2	4	13-5	3-7
" Stirrup Step					A12	16	4	6-7	3-7
" Shear Key					A21	4	4	4-8	1-8
" " "	A22	6	4	0-10					
Abutment 2									
Footing-Longit-Bott	F1	24	7	8-2					
" " Top	F2	24	5	8-2					
" Transv.	F3	60	4	5-8					
Column-Vert					A13	30	11	17-0	
" "					A14	6	8	16-4	
" Ties					A3	36	4	9-5	
" "					A4	36	4	6-11	
Cap-Horiz.	A15	14	8	40-9					
" "	A16	2	4	40-8					
" "	A7	4	4	12-0					
" "	A17	4	4	9-1½					
" Tie					A9	24	4	11-5	2-8
" "					A18	2	4	12-2	3-[illegible]
" "					A19	2	4	12-11	3-5
" "					A20	16	4	6-11	3-5
" Shear Key					A21	4	4	4-5	1-8
" " "	A22	6	4	0-10					
Pier 1									
Footing-Longit-Bott	F4	11	11	14-8					
" " " Top	F5	11	6	14-8					
" Transv-Bott	F6	12	9	10-8					
" " " Top	F7	12	4	10-8					
Column-Vert					P1A	27	14	21-10	See detail on PG 2132-C
" " Spiral					P2A	1	4	532-0	
Pier 2									
Footing-Longit-Bott	F4	11	11	14-5					
" " " Top	F5	11	6	14-5					
" Transv-Bott	F6	12	9	10-8					
" " " Top	F7	12	4	10-6					
Column-Vert					P1B	27	14	21-5	
" " Spiral					P2B	1	4	512-0	
SUPERSTRUCTURE									
Pier 1 & 2									"X" "Y"
Cap-Horiz-Bott					P3A	4	9	35-9	7-4½ 12-4½



LOCATION	STRAIGHT BARS MARK	NO.	SIZE	LENGTH	BENT BARS MARK	NO.	SIZE	LENGTH	"X"	"Y"
Cap-Horiz-Bott					P3B	4	9	35-9	6-7½	13-1½
" " "					P3C	2	9	35-9	[illegible]	[illegible]
Cap-Horiz.	P4	4	9	22-8						
" "	P5	12	9	35-8						
" "	P6	4	18	23-0						
" "	P7	4	18	29-0						
"					P8	2	14	40-10		
" "					P9	8	18	42-6		
" " Top	P10	4	8	38-0						
" " Ends					P11	8	6	6-8		
" " "					P12	8	6	6-8		
" Vert "	P13	6	6	4-4						
" Stirrups					P14	40	7	13-1		
" " Ends					P15	4	7	6-9		
					P16	48	7	15-5		
" " Top					P17	84	7	13-8		
" Ties					P18	28	4	4-6		
Diaphragms									"X"	
Horiz (Span 1)					D1A	6	8	11-10	9-2	
" -(Span 2)					D1B	6	8	11-11	9-3	
" -(Span 3)					D1C	6	8	12-1	9-5	
" (Span 1)	D2A	6	4	9-2						
" -(Span 2)	D2B	6	4	9-3						
" (Span 3)	D2C	6	4	9-5						
" " Slab	D3	18	5	10-0						
Stirrups					D4	34	4	6-3		
End Beams										
Horiz. Bott.	E1	4	8	19-6					"X"	
Horiz. Bott (End Abut 1)					E2	2	8	10-5	9-1	
" "					E3	2	8	10-6	9-2	
" Abut 1					E4	4	4	43-11	42-7	
" "					E5	2	6	44-7	42-7	
Horiz (End)					E6	6	5	5-10	5-0	
"					E7	6	5	5-10	5-0	
" Over Key	E8	9	8	6-0					"X"	
Stirrups					E9	46	5	9-3	2-5	
" Over Key					E10	4	4	8-3	1-11	
Horiz. Bott (End Abut 2)					E11	2	8	9-7	8-3	
" " " "					E12	2	8	9-5½	[illegible]	
" Abut 2					E13	4	4	[illegible]	[illegible]	
" "					E14	2	6	[illegible]	[illegible]	
Wingwalls										
Horiz (Abuts 1 & 2)	W1	4	4	5-8						
" (Abut 1)	W2A	2	4	6-8						
" (Abut 2)	W2B	2	4	6-8					"X"	
[illegible]					W3	14	5	2-10	2-0	
" (Abut 1)					W4A	4	4	8-4	7-5	
" (Abut 2)					W4B	4	4	8-2	[illegible]	
Vert	W5	22	4	3-6						
" "					W6	16	4	6-7		
" (@ Each Abut)					W7	8	5	6-2		
Vert Abut (1) & Abut 2 (R)	W8	6	4	3-3						
Horiz.	W9	4	4	4-3						



LOCATION	STRAIGHT BARS MARK	NO.	SIZE	LENGTH	BENT BARS MARK	NO.	SIZE	LENGTH	"X"
Horiz.	W10	4	4	5-7					
"					W11	8	4	6-9	6-1
"					W12	14	5	7-8	6-10
Vert Abut (1 & R) Abut 2 (L & R)	W13	6	4	3-5					



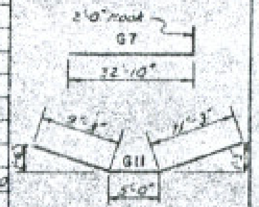
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

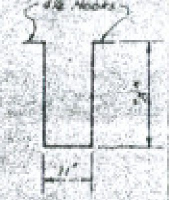
BRIDGE OVER EAST MUDDY CREEK
STA. 769+52
McCLURE PASS ROAD
COLORADO FOREST HIGHWAY PROJECT 15-1(6)

SCALE: NO SCALE

(As Constructed)

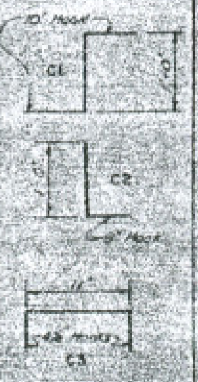
LOCATION	STRAIGHT BARS MARK	NO.	SIZE	LENGTH	BENT BARS MARK	NO.	SIZE	LENGTH	BENDING DIAGRAMS ALL DIMENSIONS ARE OUT TO OUT ("X")
SUPERSTRUCTURE (CONTINUED)									
Girders									
Longit - Top	G1	8	11	10-0					
" "	G2	16	11	35-0					
" "	G3	16	11	29-0					
" "	G4	16	11	16-0					
" - Bott Span 1 & 2	G5	8	8	8-0					
" " " "	G6	16	11	24-8					
" " " "					G7	24	11	34-10	
" " Span 2	G8	4	8	5-0					
" " " "	G9	8	11	25-0					
" " " "	G10	12	11	35-0					
" "					G11	16	11	25-6	
" Sides	G12	16	5	20-0					
" "	G13	8 lines	5	135-8	2 splices @ 1'-6" allowed per line.				
" "	G14	16	8	22-0					
" "	G15	16	8	35-0					
" "	G16	8	8	26-0					
Gdr Stirrups					G17	216	4	7-1	2-8½
" "					G18	8	4	7-1	2-8½
" "					G19	8	4	7-1½	2-8¾
" "					G20	8	4	7-2½	2-9¼
" "					G21	8	4	7-3	2-9½
" "					G22	8	4	7-3½	2-9¾
" "					G23	8	4	7-4½	2-10¼
" "					G24	8	4	7-5½	2-10¾
" "					G25	8	4	7-6½	2-11¼
" "					G26	8	4	7-7½	2-11¾
" "					G27	8	4	7-8½	3-0¼
" "					G28	8	4	7-9½	3-0¾
" "					G29	8	4	7-10½	3-1¼
" "					G30	8	4	7-11½	3-1¾
" "					G31	8ea	4	8-1½	3-2⅝ ¾" Increments
" "					to G36			to	to
" "					G37	38	4	8-10	3-7
" "					G38	8	4	8-11⅞	3-7¾
" "					G39	8	4	9-1½	3-8¾
" "					G40	8	4	9-3	3-9½
" "					G41	8	4	9-5	3-10½
" "					G42	8	4	9-7	3-11½
" "					G43	8	4	9-9	4-0½
" "					G44	8	4	9-11⅝	4-1⅜
" "					G45	8	4	9-11⅝	4-1⅜
" "					G46	8	4	9-10	4-1
" "					G47	8	4	9-8½	4-0¼
" "					G48	8	4	9-7½	3-11⅝
" "					G49	8	4	9-6	3-11
" "					G50	8	4	9-4⅝	3-10⅜
" "					G51	8	4	9-3½	3-9¾
" "					G52	8	4	9-2	3-9
" "					G53	8	4	9-1	3-8½
" "					G54	8	4	8-11⅝	3-7⅞
" "					G55	8	4	8-10⅝	3-7¼
" "					G56	8	4	8-9⅝	3-6¾



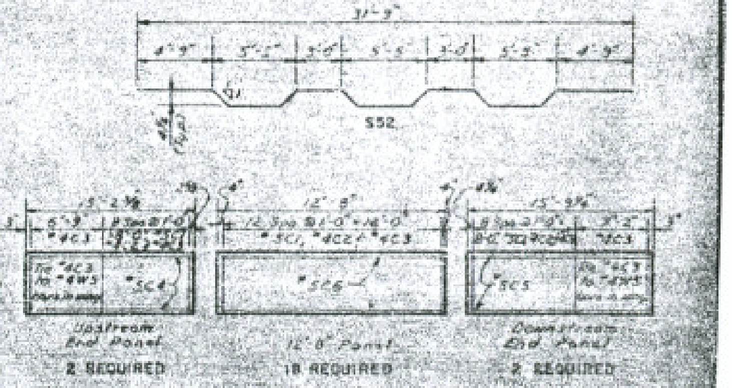


G17 THRU G82

LOCATION	STRAIGHT BARS MARK	NO.	SIZE	LENGTH	BENT BARS MARK	NO.	SIZE	LENGTH	BENDING DIAGRAMS ALL DIMENSIONS ARE OUT TO OUT ("X")
Gdr. Stirrups					G57	8ea	4	8-8	3-6 ⅛" Decrements
" "					to G64			to	to
" "					G64	8	4	8-1	3-2⅜
" "					G65	8	4	8-0⅞	3-2¼
" "					G66	8	4	7-11⅝	3-1¾
" "					G67	8	4	7-10⅝	3-1¼
" "					G68	8	4	7-10	3-1
" "					G69	8	4	7-9	3-0½
" "					G70	8	4	7-8	3-0
" "					G71	8	4	7-7½	2-11¾
" "					G72	8	4	7-6½	2-11¼
" "					G73	8	4	7-6	2-11
" "					G74	8	4	7-5	2-10½
" "					G75	8	4	7-4½	2-10¼
" "					G76	8	4	7-3½	2-9¾
" "					G77	8	4	7-3	2-9½
" "					G78	8	4	7-2½	2-9¼
" "					G79	8	4	7-2	2-9
" "					G80	8	4	7-1½	2-8¾
" "					G81	4	4	7-1	2-8½
" "					G82	4	4	7-1	2-8½
Slab									
Longit Top & Bott	S1	16 lines	5	136-0	2 Splices @ 1'-5" allowed per line				
" Top	S2	16	5	34-3					
" "	S3	16	5	27-3					
" "	S4	16	8	25-11					
" "	S5	8	5	32-10					
" "	S6	8	5	23-10					
" "	S7	8	8	23-2					
Transverse Corner	S8	2ea	6	3-1					
" "	to S49			to	⅛" Increments				
"	S50	86	6	31-1					
"	S51	185	6	31-11					
" (Bent)					S52	92	6	34-9	
" Corner	S53	2ea	6	31-0					
" "	to S89			to	⅛" Decrements				
" "	S90	75	6	2-11					
Longit @ Diaph	S91	54	5	5-0					
Curbs									
Slab Dowel					C1	210	5	2-8	
" "					C2	210	4	1-8	
Ties - Top					C3	294	4	1-6	
Longit	C4	4	5	14-6½					
	C5	4	5	15-3					
	C6	16	5	22-4					



LOCATION	STRAIGHT BARS MARK	NO.	SIZE	LENGTH	BENT BARS MARK	NO.	SIZE	LENGTH	BENDING DIAGRAMS ALL DIMENSIONS ARE OUT TO OUT
OPTIONAL GIRDER CONSTRUCTION JOINTS									Bars shown are for one girder construction joint in one girder.
Horizontal	J1	4	8	6-0					



CURB REINFORCEMENT LAYOUT

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

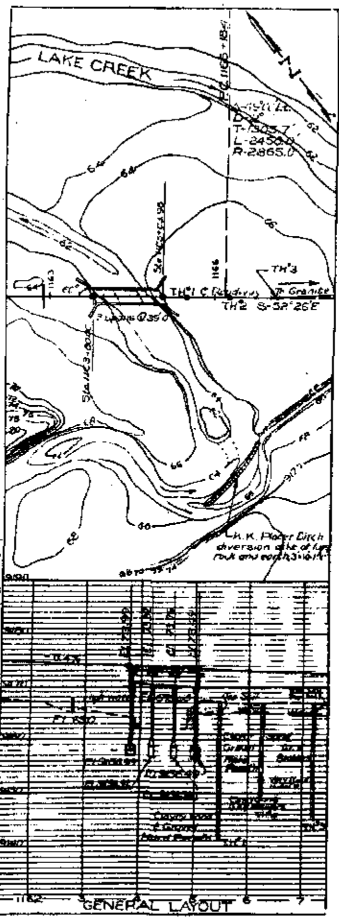
BRIDGE OVER EAST MUDDY CREEK
STA 759+52
McCLURE PASS ROAD
COLORADO FOREST HIGHWAY PROJECT

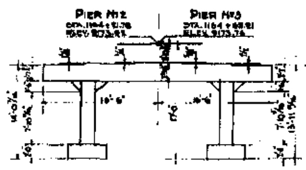
(As Constructed)

REV. 4-4-1947 JEE. GENERAL NOTES ADD ADOPTED JUNE 1, 1946; 4"-AND ONE SHOP COAT OF RED LEAD PAINT.

FED. ROAD DIST. NO.	STATE	F. A. S. PROJ. NO.	SHEET NO.	TOTAL SHEETS
3	COLO.	S-423 (3)	6-A	

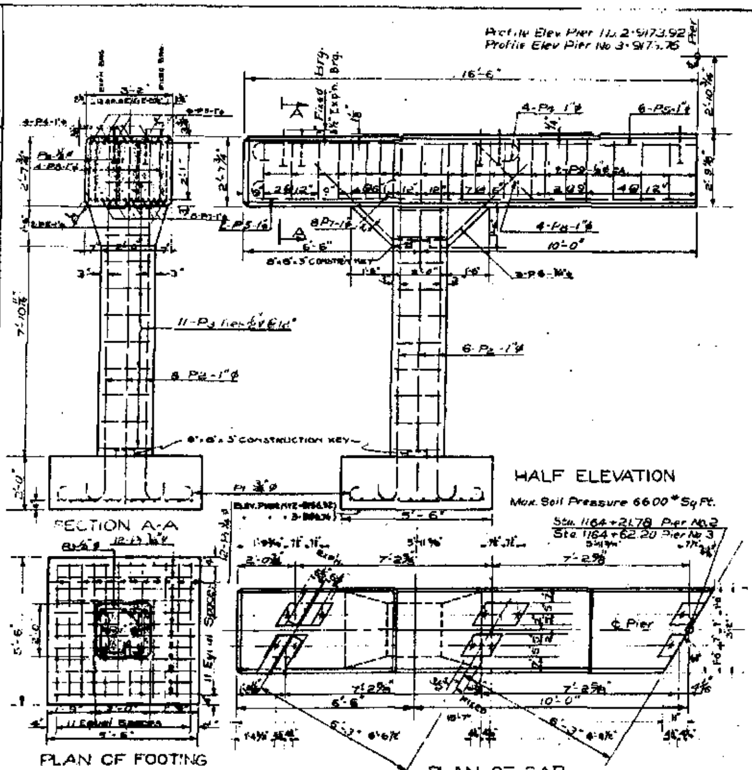
NEW SHEET 8/3/46
REVISED CONSTRUCTION DIVISIONS 9.30.46. G.H.D.
COMBINED " " 4-18-47 JEE.





LOOKING EAST

DIAGRAM OF ELEVATIONS PIERS NO 2 & 3

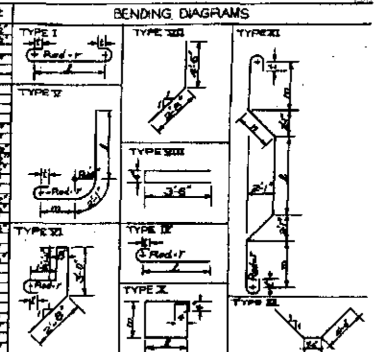


DETAIL OF PIER NO. 2 & 3

BARLIST FOR ABUTMENTS 1 & 4

MARK	SIZE	NO. OF BARS ABUT. 1	NO. OF BARS ABUT. 4	LENGTH	TYPE	l	m	n	r	t
A1	1"φ	36	36	14'-4"	[illegible]	13'-0"			4"	3⅛"
A2	[illegible]	36	36	12'-5"	[illegible]	8'-1"	3'-11"		4"	[illegible]
A3	[illegible]	34	34	23'-0"	—	BEND	IN	FIELD		
A4	[illegible]	34	34	10'-6"	[illegible]				2"	2"
A5	[illegible]	10	10	31'-7"	—	BEND	IN	FIELD		
A6	[illegible]	8	8	7'-7"	[illegible]					
A7	[illegible]	12	12	3'-9"	—					
H2	[illegible]	8	8	4'-4"	[illegible]					
H3	[illegible]	12	12	3'-6"	—					
B1	[illegible]	4	4	8'-6"	[illegible]	7'-8"			2½"	2"
B2	[illegible]	4	4	9'-6"	[illegible]	8'-8"			2½"	2"
B3	[illegible]	4	4	10'-9"	[illegible]	9'-9"			3"	[illegible]
B4	[illegible]	4	4	11'-9"	[illegible]	10'-9"			3"	[illegible]
B5	[illegible]	4	4	12'-9"	[illegible]	11'-9"			3"	[illegible]
B6	[illegible]	4	4	14'-0"	[illegible]	12'-10"			3½"	[illegible]
B7	[illegible]	4	4	15'-0"	[illegible]	13'-10"			3½"	[illegible]
B8	[illegible]	4	4	16'-3"	[illegible]	14'-11"			4"	[illegible]
B9	[illegible]	2	2	17'-1"	[illegible]	15'-9"			4"	[illegible]
B10	[illegible]	4	4	8'-9"	[illegible]	7'-8"			2½"	2"
B11	[illegible]	8	8	4'-0"	[illegible]	2'-6"	0'-7"			2½"
B12	[illegible]	8	8	7'-4"	[illegible]	3'-7"	1'-7"			
B13	[illegible]	8	8	9'-4"	[illegible]	4'-7"	1'-6"		3½"	3"
B14	[illegible]	8	8	10'-10"	[illegible]	6'-7"	2'-0"		3½"	3"
B15	1"φ	6	6	11'-11"	[illegible]	6'-2"	2'-4"		4"	3½"
B16	[illegible]	12	12	20'-3"						
B17				18'-3"						
B18				BY 2'-2"						
7A	[illegible]	2 EA.	2 EA.	3'-2"						
B33				BY 2'-2"						
F1	[illegible]	64	64	8'-8"	[illegible]	8'-10"			2½"	2"
F2	[illegible]	20	20	6'-3"	[illegible]	5'-1"			2½"	2"
F3	[illegible]	12	12	5'-1"	[illegible]	3'-1"			2½"	2"
F4	[illegible]	8	8	5'-3"	[illegible]	4'-7"			2½"	2"
F5	[illegible]	8	8	9'-6"	[illegible]	5'-8"			2½"	2"
F6	[illegible]	26	26	9'-6"	[illegible]	7'-10"			2½"	2"
F7				8'-10"		7'-10"				
F8	[illegible]	1 EA.	1 EA.	5'-4"	[illegible]	4'-8"			2½"	2"
F9				BY 3'-0"		BY 3'-0"				
F10				9'-3" TO		7'-7"				
F11	[illegible]	1 EA.	1 EA.	8'-9"	[illegible]	8'-1"			2½"	2"
F12				BY 3'-0"		BY 3'-0"				
F27	[illegible]	3	3	31'-0"	—	BEND	IN	FIELD		
F28	[illegible]	3	3	10'-6"	—					
F29	[illegible]	6	6	31'-0"	—	BEND	IN	FIELD		
F30	[illegible]	4	4	31'-0"	—	"	"	"		
F31	[illegible]	4	4	29'-0"	—	"	"	"		
F32	[illegible]	4	4	25'-6"	—					
F33	[illegible]	4	4	28'-0"	—	"	"	"		
F34	[illegible]	[illegible]	[illegible]	28'-0"	—					
F35	[illegible]	5	5	7'-6"	[illegible]	6'-6"				

1836 Lin. Ft. ⅝"φ Bars @ 0.688 Lbs. Per Lin. Ft. = 1227 Lbs.
2231 " " ⅝"φ " " 1.043 " " " " 2327 "
219 " " ¾"φ " " 1.502 " " " " 329 "
125 " " ⅞"φ " " 2.044 " " " " 256 "
1134 " " 1"φ " " 2.670 " " " " 3026 "
1%± for Overrun = 73 "
Total For Each Abutment - 7240 Lbs.



BARLIST FOR PIERS NO. 2 & 3

MARK	SIZE	NO. OF BARS PIER NO. 2	NO. OF BARS PIER NO. 3	LENGTH	TYPE	l	m	n	r	t
P1	⅝"φ	46	46	6'-4"	I	4'-4"			3"	2½"
P2	1"φ	16	16	14'-2"	[illegible]	11'-10"			4"	3⅛"
P3	⅝"φ	22	22	7'-2"	[illegible]	1'-7⅞"	1'-7⅞"			
P4	1"φ	8	8	11'-6"	[illegible]	9'-6"			4"	3⅛"
P5	1"φ	6	6	34'-4"	I	31'-6"			4"	3⅛"
P6	¾"φ	6	6	16'-9"	[illegible]					
P7	1"φ	6	6	24'-4"	I	22'-0"			4"	3⅛"
P8	1"φ	4	4	36'-1"	[illegible]	11'-10"	7'-10"	2'-11⅞"	4"	3⅛"
P9	⅝"φ	90	90	8'-6"	[illegible]	1'-9½"	2'-2⅞"			

938 Lin. Ft. ⅝"φ Bars @ 0.668 Lbs. Per Lin. Ft. = 627 Lbs.
364 " " ¾"φ " " 1.502 " " " " 547 "
936 " " 1"φ " " 2.670 " " " " 2499 "
1%± For Overrun = 37 "
Total For Each Pier = 3710 Lbs.

SUMMARY OF QUANTITIES FOR ENTIRE STRUCTURE											GRAND
ITEM	DESCRIPTION	UNIT	SUPER STR.	ABUT. NO 1	PIER NO 2	PIER NO 3	ABUT. NO 4				TOTAL
13c	UNCLASSIFIED EXCAVATION	CU. YD.		90			245				335
14a	DRY ROCK STRUCTURAL EXCAVATION	" "					10				10
14b	" COMMON " "	" "					30				30
14c	WET ROCK " "	" "		70	7	7	86				170
14d	" COMMON " "	" "		142	14	14	170				340
15v	SELECTED BACKFILL	" "		270	15	15	260				560
42a	UNTREATED BRIDGE TIMBER	M.FT. B.M.	0.35								0.35
46a	CLASS 'A' CONCRETE	CU. YD.	103.0	98.7	18	18	98.7				341
46r	" " " (HANDRAILS)	" "	9.3	0.6			0.6				10.5
47	REINFORCING STEEL (1% OVERRUN INCL'D)	LB.	~~[illegible]~~ 22190	7240	3710	3710	7240				~~[illegible]~~ 44070
48	STRUCTURAL " (1.5% " ")	"	71,120	24	47	47	24				71262
80c	SHEET COPPER (36 OZ.)	"	311								311
89a	DRAIN PIPE, CONCRETE FLOOR 4"-3'-0"	EA.	6								6
♦	½" EXPANSION JOINT MATERIAL	SQ. FT.	118	36			36				190
♦	Nº 12 GA. GALV. SHEET METAL	" "	116								116
	♦ INCLUDED IN BID PRICE OF ITEM 46a										

Note:
Details of Superstructure
See Sheet No. 6-B
Details of Abutments Nos. 1 and 4
See Sheet No. 6-C

GENERAL NOTES

ALL WORK SHALL BE DONE ACCORDING TO THE STANDARD SPECIFICATIONS OF THE COLORADO STATE HIGHWAY DEPARTMENT, ADOPTED JUNE 1, 1946.

ALL CONCRETE SHALL BE CLASS "A."

FORMS FOR CONCRETE SURFACES EXPOSED IN THE FINISHED WORK SHALL BE CONSTRUCTED OF SHIPLAP OR TONGUE AND GROOVE LUMBER S2S UNLESS FACED WITH PANEL BOARD.

CONCRETE GIRDERS, FLOOR SLABS AND CURB SHALL BE POURED MONOLITHICALLY.

FOOTINGS IN ROCK SHALL BE POURED OUT TO THE ROCK AND NOT FORMED.

ALL REINFORCING BARS SHALL BE DEFORMED AND TAGGED WITH THE STATION NUMBER AND LETTER DESIGNATION. MAIN BARS SHALL NOT BE SPLICED.

SOUNDINGS AND DEPTH OF FOOTINGS SHOWN ARE ACCORDING TO THE BEST AVAILABLE DATA. IF ESSENTIALLY DIFFERENT CONDITIONS ARE ENCOUNTERED THE BRIDGE ENGINEER WILL INSPECT AND DETERMINE IF REDESIGN IS NECESSARY.

ALL RIVETS TO BE ¾ DIA. ALL RIVETS TO BE POWER DRIVEN.

REINF. STEEL SHALL BE OF INTERMEDIATE GRADE.

ALL STRUCTURAL STEEL TO HAVE TWO FIELD COATS OF ALUMINUM PAINT, AND ONE SHOP COAT OF RED LEAD PAINT.

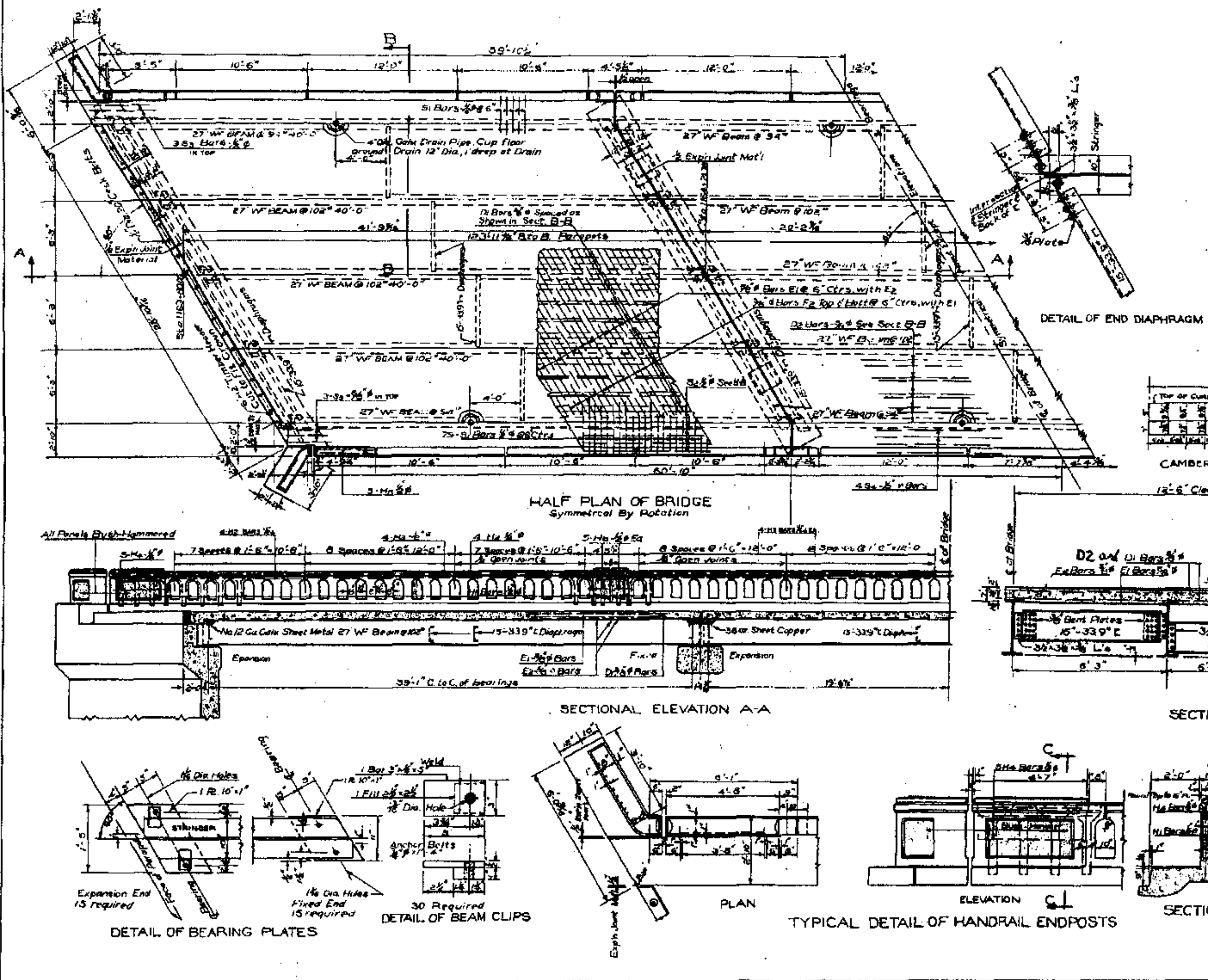
LOADING DATA.
LIVE LOAD A. A. S. H. O. [illegible] H20 44
BEAM LOAD+ALLOWANCE [illegible] LBS. PER SQ. FT. [illegible]
AT BEARING SURFACE WHICH INCLUDES THE [illegible]
CONCRETE MONOLITHIC BEARING SURFACE [illegible]

DESIGNING DATA.
fs = 15000
fc = 800
n = 12

COLORADO
STATE HIGHWAY DEPARTMENT
3 SPANS @ 39'-1" CONCRETE I BEAM
GENERAL LAYOUT, DETAILS OF PIERS, BARLIST OF ABUTMENTS AND SUMMARY OF QUANTITIES
Across LAKE CREEK
Sta. 1163+50.00 TO 1165+[illegible]
Near GRANITE Sec. 23 T. 11S R. [illegible]
Designed by G.H.D. Approved by [illegible]
Made by G.H.D. Bridge Engineer

F.A. Sec. No.	STATE	F.A.S. Proj. No.	SHEET NO.	TOTAL SHEETS
3	COLO.	S-423 (3)	6-B	

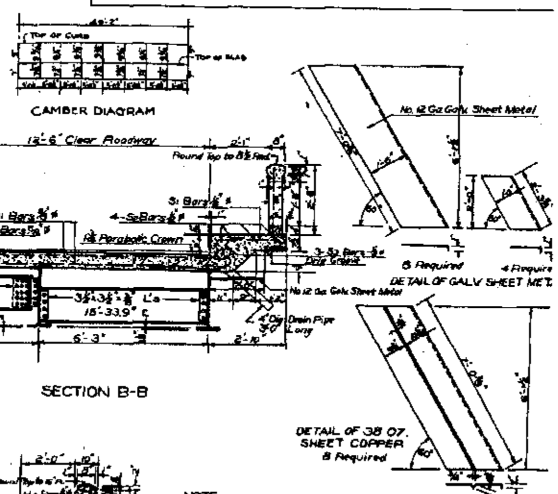
NEW SHEET 8/3/46
REVISED CONSTRUCTION DIVISIONS 9.26.46. G.H.D.
COMBINED " " 4-18-47 JEE.



BAR LIST FOR ENTIRE SUPERSTRUCTURE

MARK	SIZE	NO.	LENGTH	TYPE	l	m	r	t
E1	5/8"φ	282	32'-10½"	II			2½"	
E2	5/8"φ	71	32'-2"	I	30'-6"		2½"	2"
D1	5/8"φ	184	21'-7"	—				
D2	5/8"φ	45	40'-0"	—				
S1	½"φ	400	5'-10"	III	1'-7"	1'-6"	2"	2"
S2	½"φ	32	21'-2"	—				
S3	5/8"φ	12	4'-3"	IV	3'-5"		2½"	2"
S4	½"φ	8	39'-6"	—				
H1	½"φ	168	6'-0"	IV				
H2	½"φ	40	10'-2"	—				
H3	½"φ	32	11'-8"	—				
H4	½"φ	10	4'-7"	—				
H5	½"φ	10	3'-11"	—				
H6	½"φ	40	1'-8"	—				
H8	½"φ	24	5'-6"	—	FOR ENDPOSTS ABTS №1&4			

5933 Lin Ft. ½"φ Bars @ 0.668 Lbs. Per Lin. Ft. = 3964 LBS.
17417 Lin Ft 5/8"φ " @ 1.043 " " " " = 18166 "
1% for Overrun = 220 "
Total = 22350 LBS.



NOTE

General Layout, General Notes, Summary of Quantities and Details of Pier Nos. 2 and 3 See Sheet No. 6-A
Details of Abutments Nos. 1 and 4 See Sheet No. 6-C

COLORADO
STATE HIGHWAY DEPARTMENT
3 SPAN @ 39'-1" CONCRETE
I BEAM BRIDGE
DETAILS OF SUPERSTRUCTURE

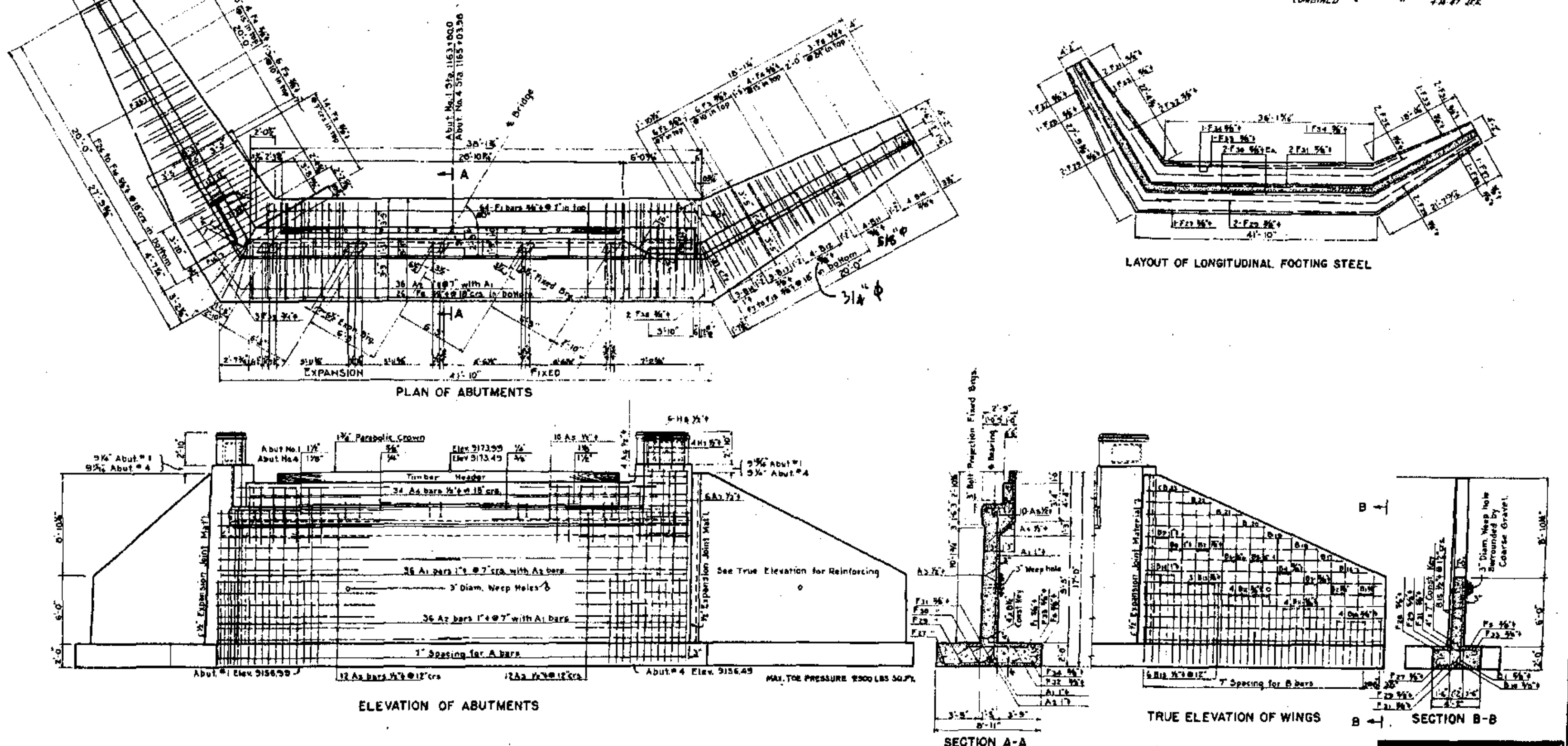
Across LAKE CREEK
Sta. 1163+60.00 to 1165+02.46
Near GRANITE Sec. 23 T. 11 S. R. 80 W.

Designed by G.H.D. | Approved by [signature] Bridge Engineer
Made by G.H.D. | Date: July 1946
Checked by W.B.M.

STRUCTURE NO. H-11-A

[illegible]	STATE	F. A. S. PROJ. NO.	SHEET NO.	TOTAL SHEETS
3	COLO.	S-423 (3)	6-C	

NEW SHEET 8/5/46
REVISED CONSTRUCTION DIVISIONS 9.20.46 G.H.D.
COMBINED " " 4.11.47 JEK



Note:
General Layout, General Notes, Summary of Quantities and Details of Piers Nos 2 & 3 See Sheet No 6-A
Details of Superstructure See Sheet No. 6-B

COLORADO
STATE HIGHWAY DEPARTMENT
3- SPANS AT 39'-1"
CONCRETE I-BEAM BRIDGE
DETAILS OF ABUTMENTS

Across Lake Creek
Sta. 1163+80.0 to 1165+03.96
Near Granite Sec. 23, T. 11 S, R. 80 W

Designed by G.H.D.	Approved by [illegible]
Made by G.H.D.	Bridge Engineer
Checked by G.H.M.	Date: July 17th 1946.

STRUCTURE NO. H-11-A

FED. ROAD DIST. NO.	STATE	PROJ. NO.	SHEET NO.	TOTAL SHEETS
3	COLO.	S 0132(1)	1	

Rev. 3-30-54, For Current "M" St'ds., J.C.R.

132.01

COLORADO
DEPARTMENT OF HIGHWAYS

PLAN AND PROFILE OF PROPOSED
FEDERAL AID PROJECT NO. S 0132(1)
STATE HIGHWAY NO. 300
LAKE COUNTY

INDEX OF SHEETS

SCALE OF ORIGINAL TRACINGS
ON PLAN, 1 IN. - 100 FT.
ON PROFILE 1 IN. - 100 FT. HORIZONTAL, 1 IN. - 10 FT. VERTICAL
GRADE LINE ON PROFILE IS SHOWN AS GRADE OF FINISHED ROAD
GROSS LENGTH OF PROJECT 12,051.6 FEET = 2.282 MILES
NET LENGTH OF PROJECT 10,993.5 FEET = 2.082 MILES

CONVENTIONAL SIGNS

CENTER LINE
RIGHT OF WAY LINE
TOWNSHIP OR RANGE LINE
SECTION LINE
QUARTER SECTION LINE
SIXTEENTH LINE
PROPERTY OR TRACT LINE
BARBED WIRE FENCE
COMBINATION WIRE FENCE
POLE FENCE
PICKET FENCE
SNOW FENCE
RAILROAD
POWER POLE LINES
TELEP. & TELEG. POLE LINES
PRESENT ROAD

TABULATION OF LENGTH & DESIGN DATA

STATION	DESCRIPTION	ROADWAY LIN. FT.	MAJOR STRUCTURE LIN. FT.	MAJOR STRUCTURE LOADING
10+00	BEGIN S 0132(1)			
22+27.38 Bk. 22+27.9 Ah.	EQUA.	1227.3		
44+90	Bridge End	2262.1		
	Lake Fork Creek		58.5	H-20-44
45+48.5	Bridge End	5975.6		
103+24.1	Begin No Work Section=Opp. 120+45.5 on F.A.S. 8A(1)	161.1		
	Str. No. H-11-AA Arkansas River		159.3	H-15-35
		580.7		
	Str. No. H-11-AB Calif. Gulch		24.1	H-15-35
		132.9		
131+00 Ah.	End No Work Section=End F.A.S. 8A(1)			
145+70	END S 0132(1)= Opp. Sta. 193+09.6 on FAP E248-E	1470.0		
	TOTALS WORK SECTION	10933.0	58.5	
	TOTALS NO WORK SECTION	874.7	183.4	
	SUMMARY		LIN. FT.	MILES
	Roadway		[illegible]	2.071
	Bridges		58.5	0.011
	No Work Section		1,058.1	0.200
	GROSS LENGTH OF PROJECT		12,051.6	[illegible]
	NET LENGTH OF PROJECT		10,993.5	[illegible]

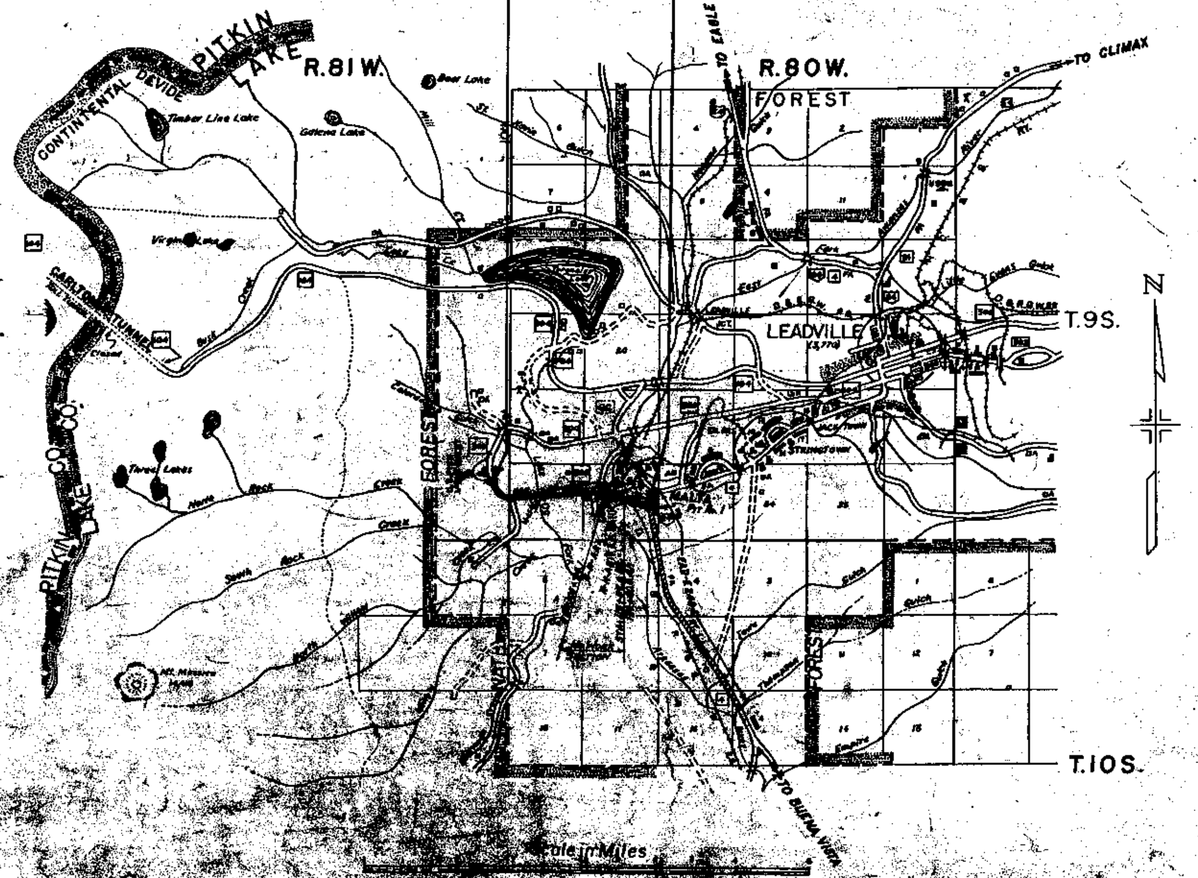
NO WORK SECTION

DESIGN DATA

Maximum Degree of Curve	8°00'
Maximum Grade	2.60%
Minimum N.P.S.D. — Horizontal	[illegible]
Minimum N.P.S.D. — Vertical	360'
Maximum Design Speed	50 M.P.H.

STA. 10+00=BEGIN S 0132(1)

STA. 145+70.0=END S 0132(1)
OPP. STA. 193+09.6 on F.A.P. E 248-E



NOTICE TO BIDDERS
It is recommended that Bidders on this project go over the plan details with one of the following field representatives of the Department.
F.C. Hammond, Resident Engineer, Glenwood Springs, Colo.
Homer W. Gray, Construction Engineer, Grand Junction, Colo.

COLORADO
DEPARTMENT OF HIGHWAYS
APPROVED:
Mark U. Watson
CHIEF ENGINEER
DATE

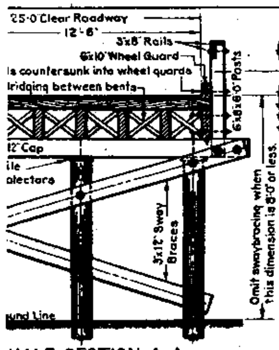
DEPARTMENT OF COMMERCE
BUREAU OF PUBLIC ROADS
APPROVED:
DATE
DISTRICT ENGINEER

STANDARD P-118-BH

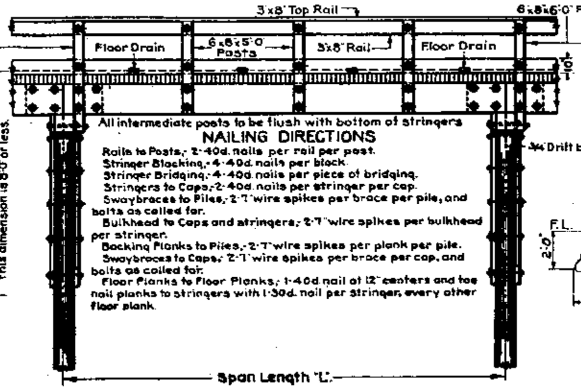
MODIFIED - Wings - Rip Rap added

Revised 6-27-52 for 1952 Specifications J.R.J.

FED. ROAD DIVISION NO.	DISTRICT	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	50132 (1)	5	



HALF SECTION A-A
HALF BENT AND SPAN SECTION

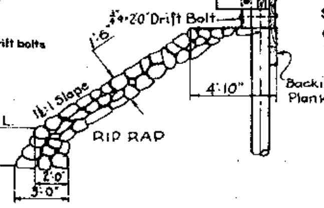


All intermediate posts to be flush with bottom of stringers.

NAILING DIRECTIONS

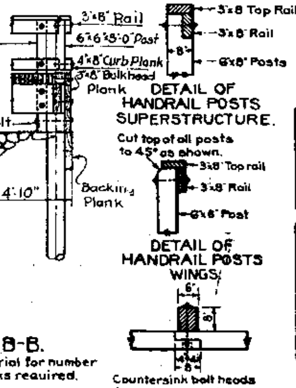
Rails to Posts, 2-40d. nails per rail per post.
Stringer Blocking, 4-40d. nails per block.
Stringer Bridging, 4-40d. nails per piece of bridging.
Stringers to Caps, 2-40d. nails per stringer per cap.
Swaybraces to Piles, 2-7" wire spikes per brace per pile, and bolts as called for.
Bulkhead to Caps and stringers, 2-7" wire spikes per bulkhead per stringer.
Backing Planks to Piles, 2-7" wire spikes per plank per pile.
Swaybraces to Caps, 2-7" wire spikes per brace per cap, and bolts as called for.
Floor Planks to Floor Planks, 1-40d. nail at 12" centers and toe nail planks to stringers with 1-30d. nail per stringer, every other floor plank.

TYPICAL ELEVATION OF SPAN



SECTION B-B.

See bill of material for number of backing planks required.



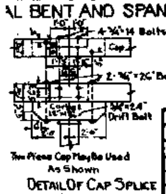
DETAIL OF HANDRAIL POSTS SUPERSTRUCTURE.

Cut top of all posts to 45° as shown.

DETAIL OF HANDRAIL POSTS WINGS.

Countersink bolt heads into wheel guards.

PLAN VIEW. DETAILS OF WHEEL GUARD SPLICE

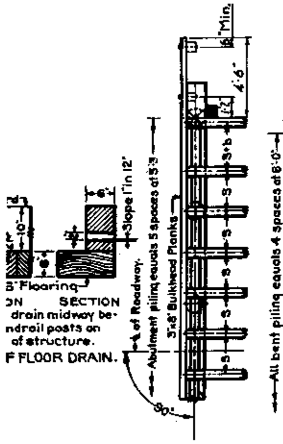


Two Piece Cap May Be Used As Shown

DETAIL OF CAP SPLICE

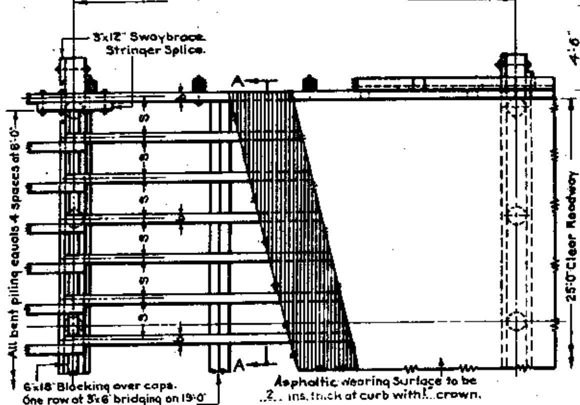
STRINGER SPACING				STRINGER BLOCKING		
L	S	S	NUMBER OF	ABUTMENTS		BENTS
SPAN LENGTH	SINGLE SPAN	MULTIPLE SPAN	STRINGERS	SINGLE SPAN	MULTIPLE SPAN	MULTIPLE SPAN
19'-0"	2'-3 5/16"	2'-3¼"	12	11 Pcs. 1'-9 1/16"	10 Pcs. 1'-9¼, 1 Pc. 2'-3¼"	11 Pcs. 1'-9¼"
23'-0"	2'-3 5/16"	2'-3¼"	12	11 Pcs. 1'-9 1/16"	10 Pcs. 1'-9¼, 1 Pc. 2'-3¼"	11 Pcs. 1'-9¼"
27'-0"	2'-3 5/16"	2'-2⅞"	12	11 Pcs. 1'-7⅞"	10 Pcs. 1'-6⅞, 1 Pc. 2'-2⅞"	8 Pcs. 10⅞, 2 Pcs. 1'-0⅞"

SPACING OF HANDRAIL POSTS.
4 Spaces of 4'-9" for 19'-0" spans.



SECTION
Floor drain midway between handrail posts on each side of structure.
DETAIL OF FLOOR DRAIN.

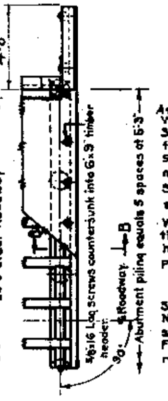
SECTIONAL HALF PLAN OF ABUTMENT



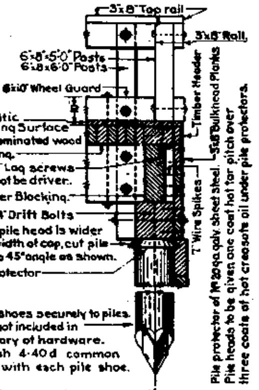
6"x18" Blocking over caps.
One row of 3"x6" bridging on 19'-0" spans and 2 rows of bridging on 23'-0" and 27'-0" spans.

Asphaltic Wearing Surface to be 2" ins. thick at curb with ½" crown.

TYPICAL SECTIONAL HALF PLAN OF SPANS



HALF PLAN OF ABUTMENT

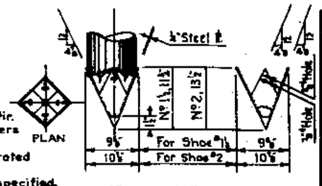


Asphaltic Wearing Surface
3"x6" Laminated wood flooring.
5/8"x16" Lag screws must not be driven.
Stringer Blocking.
3/4"x24" Drift Bolts
When pile head is wider than width of cap, cut pile head to 45° angle as shown.
Pile Protector

Spike shoes securely to piles. Nails not included in summary of hardware. Furnish 4-40d common nails with each pile shoe.

Pile protector of № 20 ga. galv. sheet steel. Pile heads to be given one coat hot tar pitch over three coats of hot creosote oil under pile protectors.

SECTION THRU ABUTMENT



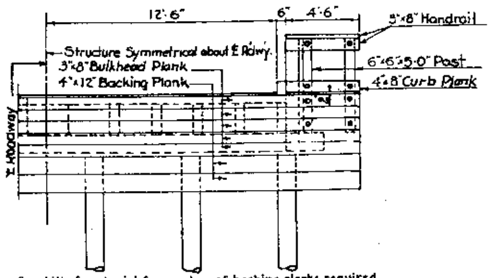
DETAIL OF PILE SHOE

Furnish American Pulley Co's Pile Shoe or equivalent. Where pile shoes are specified use № 1½ shoe for pile tips 2"-9" and № 2 shoe for pile tips > 9". Wt. № 1½ 8 lbs. Wt. № 2, 13½ lbs.

GENERAL NOTES (CONT)

Contractors' attention is called to Specifications covering Mechanical Tamping. Special care must be used to prevent deflection of Abutments and Wings by wedging action. Backfill in 8 in. earth layers shall be mechanically tamped beginning at the wall and proceeding outward.

Below channel elevation mechanically tamp uniformly on both sides. Above original ground line mechanically tamp out to 6 ft. from the wall. Rolling equipment shall not be used within 6 ft. of any wall.



See bill of material for number of backing planks required.

HALF END ELEVATION

NOTE: Flooring may be random lengths providing the joints are placed over the stringers and not closer than every third plank.

	INITIAL	DATE
	W.L.P.	8-10-53
	A.B.H.	6-14-55
	W.L.P.	8-10-53
	A.B.H.	6-14-55

STANDARD P-118-BH.

GENERAL NOTES.

All work shall be done according to the Standard Specifications of The Colorado Department of Highways applicable to the project.

All timber and piling to be treated or untreated as shown in bills of material.

All timber and piling shall be dense southern yellow pine or west coast douglas fir.

All caps shall be edged to an even depth. The ends of all stringers shall be dapped on one edge to obtain an even depth over caps.

All cut surfaces or bored holes in treated timber or piles shall be thoroly saturated with hot creosote oil.

All piling supporting caps shall be covered with galvanized pile protectors as specified, all other piling tops shall be saturated with hot creosote oil and covered with a thick layer of heavy asphalt or tar.

Joints in top handrail must be staggered with joints in side rail.

All handrailing and posts above the wheel guards shall be painted white and all handrail posts below the top of wheel guards shall be painted black as specified.

All bolts more than 12" long must be threaded not less than 4 inches.

Bolts in the finished structure shall not project more than one half inch beyond the nut.

All bolts must have Std. C.I.O.G. or Malleable Cast Washers under each head and nut.

Bolt lengths are calculated assuming Std. C.I.O.G. washers will be used.

The contractor is cautioned to check bolt lengths before ordering because of variations in thickness of lumber and piling.

The entire exposed surface of all untreated timber shall be painted one coat as specified immediately after the material is delivered to the project.

Before placing handrailing the contact surfacing shall receive the second coat of paint.

When contractor is permitted to drill holes to facilitate pile driving, these holes must be drilled so piling will stand in vertical position after final driving.

All hardware except nails to be galvanized. Weights of hardware as shown are for ungalvanized material.

All necessary blocking for swaybracing shall be treated timber.

All caps must be surfaced on vertical grain face.

BOLTS AND WASHERS FOR ONE SPAN OF SUPERSTRUCTURE

LOCATION	SIZE	19'-0" SPAN NO.	LENGTH	TOTAL	23'-0" SPAN NO.	LENGTH	TOTAL	27'-0" SPAN NO.	LENGTH	TOTAL
POSTS TO RAILS	5/8"	6	10"	7.0 LBS.	6	10"	7.0 LBS.	8	10"	9.0 LBS.
POSTS TO WHEEL GUARDS	3/4"	6	14"	12.7 LBS.	6	14"	12.7 LBS.	8	14"	17.0 LBS.
POSTS TO STRINGERS	3/4"	12	16"	28.3 LBS.	12	16"	28.3 LBS.	16	16"	42.0 LBS.
WHEEL GUARDS TO STRINGERS	3/4"	6	36"	29.0 LBS.	6	36"	30.0 LBS.	8	36"	40.0 LBS.
WASHERS-STD. C.I.O.G. 5/8 & 3/4"		12/48		69.0 LBS.	12/48		69.0 LBS.	16/64		92.0 LBS.
TOTAL WEIGHT				146.0 LBS.			147.0 LBS.			200.0 LBS.

BOLTS AND WASHERS FOR ONE ABUTMENT

LOCATION	ITEM	SIZE	NO.	LENGTH	WT. EACH	TOTAL WT.
POSTS TO RAILS	BOLTS	5/8"	2	10"	1.08 LBS.	2.2 LBS.
POST TO BULKHEAD TO CAP	BOLTS	5/8"	2	23"	2.15 LBS.	4.3 LBS.
POSTS TO STRINGERS	BOLTS	3/4"	4	16"	2.60 LBS.	10.4 LBS.
POSTS TO WHEEL GUARDS	BOLTS	3/4"	2	14"	2.12 LBS.	4.3 LBS.
WHEEL GUARDS TO STRINGERS	BOLTS	3/4"	2	36"	5.00 LBS.	10.0 LBS.
TIMBER HEADER TO STRINGERS	LAG SCREWS	5/8"	12	16"	1.36 LBS.	16.3 LBS.
POSTS TO BULKHEAD & CURB PLNK & HANDRL	BOLTS	5/8	12/4	11"/12"	116/124 LBS.	19.0 LBS.
WASHERS-STD. C.I.O.G.	WASHERS 5/8-3/4	52/16		0.75/1.25 LBS.		59.0 LBS.
CAP TO PILES	DRIFT BOLTS	3/4"	6	24"	3.00 LBS.	18.0 LBS.
TOTAL WEIGHT						144.0 LBS.

BOLTS AND WASHERS FOR ONE BENT

POSTS TO RAILS	BOLTS	5/8"	2	10"	1.08 LBS.	2.2 LBS.
POSTS TO WHEEL GUARDS	BOLTS	3/4"	2	14"	2.12 LBS.	4.3 LBS.
POSTS TO CAP WITHOUT SWAYS	BOLTS	5/8"	2	20"	1.90 LBS.	3.8 LBS.
WHEEL GUARDS TO STRINGERS	BOLTS	3/4"	2	36"	5.00 LBS.	10.0 LBS.
POSTS TO STRINGERS TO SPLICES	BOLTS	3/4	4	24"	3.32 LBS.	13.3 LBS.
SPLICES TO STRINGERS	BOLTS	5/8"	12	16"	1.57 LBS.	18.9 LBS.
POSTS TO CAP TO SWAYBRACES	BOLTS	5/8"	2	23"	2.15 LBS.	4.3 LBS.
SWAYBRACES TO CAP	BOLTS	5/8"	2	17"	1.66 LBS.	3.3 LBS.
SWAYBRACES TO PILES	BOLTS	5/8"	8	17"	1.66 LBS.	13.3 LBS.
SWAYBRACE TO PILE TO SWAYBRACE	BOLTS	5/8"	1	20"	1.90 LBS.	1.9 LBS.
					LBS.	LBS.
WASHERS-STD. C.I.O.G. NO SWAYS.	WASHERS 5/8-3/4	32/16		0.75/1.25 LBS.		44.6 LBS.
WASHERS-STD. C.I.O.G. WITH SWAYS	WASHERS 5/8-3/4	54/16		0.75/1.25 LBS.		60.5 LBS.
CAPS TO PILES	DRIFT BOLTS	3/4"	5	24"	LBS.	15.0 LBS.
TOTAL WEIGHT - WITHOUT SWAYBRACES						112.0 LBS.
TOTAL WEIGHT - WITH SWAYBRACES						147.0 LBS.

NAILS

LOCATION	ITEM	19'-0" SPAN	23'-0" SPAN	27'-0" SPAN
ONE SPAN OF SUPERSTRUCTURE	30D. COMMON	25 LBS.	30 LBS.	35 LBS.
		LBS.	LBS.	LBS.
	40D. COMMON	135 LBS.	165 LBS.	155 LBS.
ONE ABUTMENT	40D. COMMON	6 LBS.	5 LBS.	5 LBS.
	7" WIRE SPIKES	24 LBS.	LBS.	LBS.
	40D. COMMON	1 LB.	1 LB.	1 LB.
	7" WIRE SPIKES	LBS.	LBS.	LBS.
ONE BENT	40D. COMMON	5 LBS.	5 LBS.	5 LBS.
	7" WIRE SPIKES	5 LBS.	LBS.	LBS.

SUMMARY OF HARDWARE

BOLTS AND WASHERS	3 SPANS	AT	146 LBS. PER SPAN	438 LBS.
	2 ABUTMENTS	AT	144 LBS. PER ABUTMENT	288 LBS.
		AT	LBS. PER	LBS.
	2 BENTS WITH SWAYBRACES	AT	147 LBS. PER BENT	294 LBS.
	TOTAL WEIGHT			1020 LBS.

NAILS	LOCATION	UNIT	30D COMMON EACH	30D COMMON TOTAL	EACH	TOTAL	40D COMMON EACH	40D COMMON TOTAL	7" WIRE SPIKES EACH	7" WIRE SPIKES TOTAL
	3 SPANS	LBS.	25	75			135	405		
	2 ABUTMENTS	LBS.					6	12	24	48
		LBS.								
	2 BENTS	LBS.					5	10	5	10
	TOTAL WEIGHT	LBS.		75				427		58

ONE SPAN OF SUPERSTRUCTURE

DESCRIPTION	SIZE	19'-0" SPAN NO.	LENGTH	TOTAL	23'-0" SPAN NO.	LENGTH	TOTAL	27'-0" SPAN NO.	LENGTH	TOTAL
UNTREATED TIMBER										
HANDRAILS S4S.	3"x8"	4	20'-0"	160 BD.FT.	4	24'-0"	192 BD.FT.	4	28'-0"	224 BD.FT.
HANDRAIL POSTS S4S	6"x8"	6	5'-0"	120 BD.FT.	6	5'-0"	120 BD.FT.	8	5'-0"	160 BD.FT.
TOTAL UNTREATED TIMBER				280 BD.FT.			312 BD.FT.			384 BD.FT.
TREATED TIMBER										
FLOORING *	3"x6"	87	24'-0"	3393 BD.FT.	105	26'-0"	4095 BD.FT.	124	26'-0"	4836 BD.FT.
BRIDGING	3"x6"	4	14'-0"	84 BD.FT.	8	14'-0"	168 BD.FT.	8	14'-0"	168 BD.FT.
WHEEL GUARDS ▼	6"x10"	2	20'-0"	200 BD.FT.	2	24'-0"	240 BD.FT.	2	28'-0"	280 BD.FT.
STRINGERS OUTSIDE INTERMEDIATE SPAN	6"x18"	2	19'-0"	342 BD.FT.						
	6"x20"				2	23'-0"	460 BD.FT.			
	8"x20"							2	27'-0"	720 BD.FT.
STRINGERS OUTSIDE END SPANS	6"x18"	2	19'-6"	351 BD.FT.						
	6"x20"				2	23'-6"	470 BD.FT.			
	8"x20"							2	27'-6"	734 BD.FT.
STRINGERS INSIDE INTERMEDIATE AND END SPANS	6"x18"	10	20'-0"	1800 BD.FT.						
	6"x20"				10	24'-0"	2400 BD.FT.			
	8"x20"							10	28'-0"	3734 BD.FT.
STRINGERS SINGLE SPAN	6"x18"	12	20'-0"	2160 BD.FT.						
	6"x20"				12	24'-0"	2880 BD.FT.			
	8"x20"							12	28'-0"	4480 BD.FT.
TOTAL TREATED TIMBER-SINGLE SPAN				5837 BD.FT.			7365 BD.FT.			9764 BD.FT.
TOTAL TREATED TIMBER-END SPAN				5828 BD.FT.			7373 BD.FT.			9752 BD.FT.
TOTAL TREATED TIMBER-INTER SPAN				5819 BD.FT.			7363 BD.FT.			9738 BD.FT.
ASPHALTIC WEARING SURFACE ▲				25 TONS			TONS			TONS

ONE ABUTMENT

UNTREATED TIMBER			
HANDRAIL POSTS S4S.	2/4 PCS.	6"x8"x6'-0" / 6"x6"x5'-0"	108 BD.FT.
HANDRAILS S4S	4 PCS.	3"x8"x4'-6"	36 BD.FT.
TREATED TIMBER \ TOTAL UNTR. TIMBER			144 BD.FT.
TIMBER HEADER	1 PC.	6"x3"x26'-0"	117 BD.FT.
CAP	1 PC.	12"x12"x30'-0"	360 BD.FT.
BULKHEAD PLANKS	5 PCS.	3"x8"x22'-0"	270 BD.FT.
BULKHEAD PLANKS	5 PCS.	3"x8"x16'-0"	160 BD.FT.
STRINGER BLOCKING Cut before treatment — 19' & 23' SPANS	1 PC.	6"x18"x22'-0"	198 BD.FT.
STRINGER BLOCKING Cut before treatment — 27' SPANS	1 PC.		BD.FT.
CURB PLANK	2 PC.	4"x8"x4'-6"	24 BD.FT.
BACKING PLANK	2 PC.	4"x12"x22'-0"	176 BD.FT.
BACKING PLANK	2 PC.	4"x12"x16'-0"	128 BD.FT.
TOTAL TREATED TIMBER			1381 BD.FT.
PILING TREATED	6 PCS. @ 22'-0" LINEAL FT. EACH		132 LIN.FT.

ONE BENT

UNTREATED TIMBER			
HANDRAIL POSTS S4S.	2 PCS.	6"x8"x6'-0"	48 BD.FT.
TOTAL UNTREATED TIMBER			48 BD.FT.
TREATED TIMBER			
STRINGER SPLICES	2 PCS.	6"x18"x4'-0"	72 BD.FT.
CAP	1 PC.	12"x12"x30'-0"	360 BD.FT.
SWAYBRACES	2 PCS.	3"x12"x30'-0"	180 BD.FT.
STRINGER BLOCKING Cut before treatment — 19' & 23' SPANS	1 PC.	6"x18"x16'-0"	144 BD.FT.
~~STRINGER BLOCKING Cut before treatment — 27' SPANS~~	~~1 PC.~~	~~6"x18"x12'-0"~~	BD.FT.
~~SHIMS~~	~~12 PCS.~~	~~2"x6"x1'-0"~~	BD.FT.
			BD.FT.
TOTAL TREATED TIMBER			756 BD.FT.
PILING-TREATED	5 PIECES AT 22'-0" LINEAL FT. EACH		110 LIN.FT.

* 50% S2S - 50% S2S, 1E ¼" off

▼ Lengths of Wheel Guards	SPANS	19'-0"	~~23'-0"~~	~~27'-0"~~
	SINGLE	~~19'-0"~~	~~23'-0"~~	~~27'-0"~~
	END	18'-7"	~~22'-7"~~	~~26'-7"~~
	END	20'-0"	~~24'-0"~~	~~28'-0"~~
	INTERMEDIATE	19'-8"	~~23'-8"~~	~~27'-8"~~

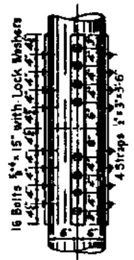
SUMMARY OF QUANTITIES

STRUCTURAL EXCAVATION				
ITEM 14a DRY ROCK			5	CU.YDS.
ITEM 14b DRY COMMON			16	CU.YDS.
ITEM 14c WET ROCK			5	CU.YDS.
ITEM 14d WET COMMON			5	CU.YDS.
ITEM 16a STRUCTURE BACKFILL			11	CU.YDS.
ITEM 16c MECHANICAL TAMPING			5	HOURS
ITEM 42a UNTREATED BRIDGE TIMBER				
3 SPANS	AT	280 BD.FT. EACH=	840	BD.FT.
2 ABUTMENTS	AT	144 BD.FT. EACH=	288	BD.FT.
	AT	BD.FT. EACH=		BD.FT.
2 BENTS	AT	48 BD.FT. EACH=	96	BD.FT.
		TOTAL=	1224	BD.FT.
ITEM 42b TREATED BRIDGE TIMBER				
2 SPANS	AT	5828 BD.FT. EACH=	11656	BD.FT.
1 SPANS	AT	5819 BD.FT. EACH=	5819	BD.FT.
2 ABUTMENTS	AT	1381 BD.FT. EACH=	2762	BD.FT.
	AT	BD.FT. EACH=		BD.FT.
2 BENTS	AT	756 BD.FT. EACH=	1512	BD.FT.
		TOTAL=	21749	BD.FT.
ITEM 60a PILING-TREATED				
2 ABUTMENTS	AT	132 LIN.FT. EACH=	264	LIN.FT.
	AT	LIN.FT. EACH=		LIN.FT.
2 BENTS	AT	110 LIN.FT. EACH=	220	LIN.FT.
		TOTAL=	484	LIN.FT.
ITEM 60e METAL PILE SHOES		See Detail	22	SHOES
ITEM 67J RIP RAP			56	CU.YDS.

▲ MATERIAL FURNISHED & WORK DONE BY STATE FORCES
FOR OVERHAUL ON STRUCTURE BACKFILL SEE PROJECT SUMMARY.

The preservative for all treated timber and piling shall be creosote oil.

ITEM 11a. REMOVAL OF BRIDGE	L.S.	
ITEM 13C UNCLASSIFIED EXCAVATION	190	CU.YDS.



PILE SPLICE
Bolts and Straps Galv.
Note: Bolt length given for 12" dia. Pile.

Note (32) Deform nails to be installed by Engineering forces.

STRUCTURES REQUIRED
Asphaltic 3 SPANS AT 19'-0"
Asphaltic Surface to extend 10 ft. beyond each abutment.

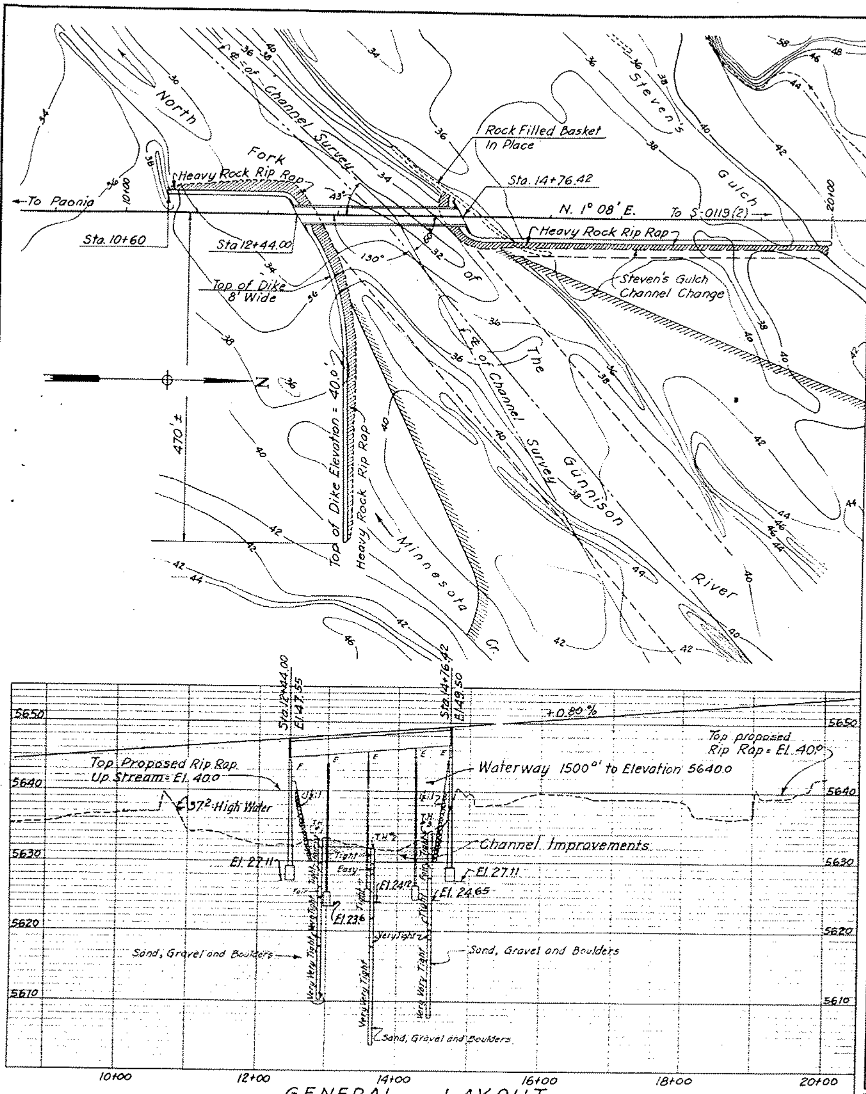
LOADING DATA.
LIVE LOAD - A.A.S.H.O. 1944 H-20-44
DEAD LOAD - Assumes 25 lbs. per sq. ft. additional wearing surface. This includes asphaltic wearing surface. No impact for 180° lbs. per...

COLORADO DEPARTMENT OF HIGHWAYS
TREATED TIMBER PILE TRESTLE WITH 6" LAMINATED WOOD FLOOR & ASPHALTIC WEARING SURFACE
25 FT. CLEAR ROADWAY
Across LAKE FORK CREEK
Sta. 44+90.0 to 45+48.5
Near MALTA Sec. 31 T. 9 S. R. 80 W.

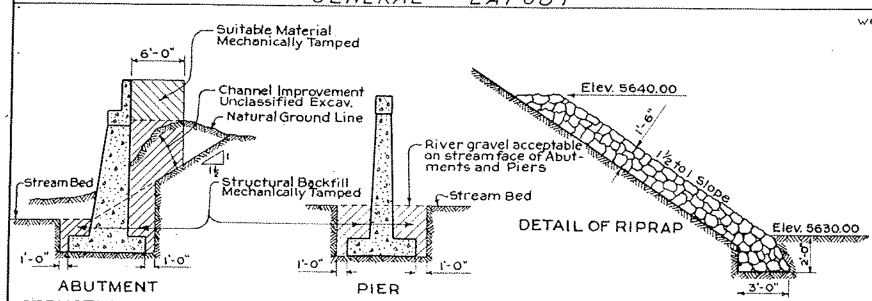
Designed by MFM	Approved by
Made by H.G.S.A.G.H.	Bridge Engineer
Check Design HWP	Date: May 1, 1959
Check Detail HWP	

STRUCTURE NO. H-11-U

FED. ROAD DIV. NO.	DISTRICT	PROJECT NO.	SHEET NO.
9	COLO.	S 0119-(11)	7



GENERAL LAYOUT



ABUTMENT

PIER

DETAIL OF RIPRAP

STRUCTURE BACKFILL & MECHANICAL TAMPING DIAGRAMS

All material that is to be mechanically tamped, shall be placed in horizontal layers not more than 6 inches in depth and tamped before the next layer is placed.

BAR LIST SUPERSTRUCTURE

LWF / A.E.S.

MARK	SIZE	NO. REQD.	LENGTH	TYPE	DIMENSIONS ℓ	m	n
460	½"φ	122	26'-8"	Str.			
461	½"φ	12	27'-8"	Str.			
462	½"φ	268	31'-10"	Str.			
463	½"φ	122	26'-0"	Str.			
464	½"φ	12	27'-0"	Str.			
465	½"φ	96	4'-5"	I	1'-2½"	0'-8"	
466	½"φ	14	2'-11"	Str.			
525	⅝"φ	342	38'-10"	Str.			
526	⅝"φ	169	40'-1"	VII			
527	⅝"φ	400	4'-7"	VIII			
615	¾"φ	8	10'-1"	III	4'-6"	1'-1"	

BAR SUMMARY SUPERSTRUCTURE

16,078 Lin. Ft. ½"φ bar @ 0.668#/lin. ft. = 10,740 lbs.
21,888 " " ⅝"φ bar @ 1.043#/ " " = 22,829 "
81 " " ¾"φ bar @ 1.502#/ " " = 122 "
1% ± for Overrun = 334 "
Total = 34,025 "

BAR LIST PIER No. 2 (Same for 3 & 4)

P.C. / A.E.S.

MARK	SIZE	NO. REQD.	LENGTH	TYPE	DIMENSIONS ℓ	m	n
415	½"φ	1	15'-8"	Str.			
416 to 427	do	1 ea.	7'-1" by 2" to 8'-11"	I	1'-7¼" by ½" to 2'-0¾"	1'-7¼" by ½" to 2'-0¾"	
428 to 439	do	1 ea.	7'-9" by 2¼" to 9'-9¼"	V	1'-7¼" by ½" to 2'-0¾"	1'-7¼" by ½" to 2'-0¾"	
440	do	18	22'-6"	Str.			
441	do	20	17'-2"	III	0'-8"	8'-3"	
442	do	74	10'-1½"	I	1'-2¾"	3'-6"	
605	¾"φ	36	6'-9"	Str.			
606	do	6	11'-0"	IV	2'-0"	4'-6"	
905	1⅛"φ	4	5'-8"	Str.			
906	do	4	13'-1"	Str.			
1010	1¼"φ	3	10'-6"	Str.			
1011	do	6	11'-6"	Str.			
1012	do	8	36'-6"	Str.			
1101	1⅜"φ	8	18'-0"	Str.			

* BAR SUMMARY PIER No. 2

A.E.S. / D.S.M.

1714 Lin. Ft. ½"φ bar @ 0.668#/lin. ft. = 1145 lbs.
309 " " ¾"φ " @ 1.502#/ " " = 464 "
75 " " 1⅛"φ " @ 3.400#/ " " = 255 "
393 " " 1¼"φ " @ 4.303#/ " " = 1691 "
144 " " 1⅜"φ " @ 5.313#/ " " = 765 "
1% ± for Overrun = 45 "
Total = 4365 "

* Same for Piers No. 3 & 4

BAR LIST ABUT. No. 1

P.C. / A.E.S.

MARK	SIZE	NO. REQD.	LENGTH	TYPE	DIMENSIONS ℓ	m	n
401	½"φ	8	11'-4"	I	1'-8"	3'-8"	
402	do	12	9'-10"	I	1'-8"	2'-11"	
403	do	4	8'-4"	I	1'-8"	2'-2"	
404	do	41	15'-8"	II	2'-6½"		
405	do	4	19'-1"	II	4'-3"		
406	do	4	18'-9"	II	4'-1"		
407	do	12	26'-0"	Str.			
408	do	16	3'-0"	Str.			
409	do	2	8'-6"	III	0'-8"	3'-11"	
410	do	2	10'-6"	III	0'-8"	4'-11"	
501	⅝"φ	16	3'-10"	Str.			
502	do	34	5'-6"	Str.			
503	do	4	5'-2"	Str.			
504	do	4	11'-0"	Str.			
505	do	8	16'-0"	Str.			
601	¾"φ	24	10'-0"	Str.			
602	do	6	8'-8"	IV	2'-0"	3'-4"	
603	do	2	47'-2"	Str.			
901	1⅛"φ	4	10'-10"	Str.			
902	do	6	16'-0"	Str.			
1001	1¼"φ	4	9'-0"	Str.			
1002	do	4	12'-0"	Str.			
1003	do	2	9'-6"	Str.			
1004	do	2	15'-6"	Str.			
1005	do	4	47'-2"	Str.			

BAR SUMMARY ABUT. No. 1

A.E.S. / D.S.M.

1434 Lin. Ft. ½"φ bar @ 0.668#/lin. ft. = 958 lbs.
441 " " ⅝"φ " @ 1.043#/ " " = 460 "
386 " " ¾"φ " @ 1.502#/ " " = 580 "
139 " " 1⅛"φ " @ 3.400#/ " " = 473 "
323 " " 1¼"φ " @ 4.303#/ " " = 1390 "
1% ± for Overrun = 39 "
Total = 3900 "

BAR LIST ABUT. No. 5

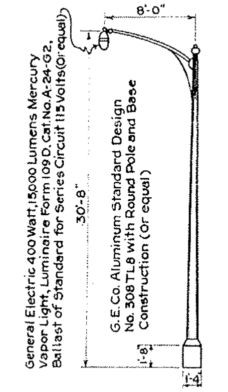
P.C. / A.E.S.

MARK	SIZE	NO. REQD.	LENGTH	TYPE	DIMENSIONS ℓ	m	n
445	½"φ	6	11'-10"	I	1'-8"	3'-11"	
446	do	12	10'-4"	I	1'-8"	3'-2"	
447	do	8	8'-4"	I	1'-8"	2'-2"	
448	do	35	19'-3"	VI			
449	do	7	20'-7"	II	5'-0"		
450	do	7	21'-1"	II	5'-3"		
451	do	8	3'-0"	Str.			
452	do	2	10'-6"	III	0'-8"	4'-11"	
453	do	2	12'-6"	III	0'-8"	5'-11"	
454	do	2	24'-9"	Str.			
455	do	12	26'-0"	Str.			
456	do	2	7'-3"	Str.			
457	do	2	6'-9"	Str.			
520	⅝"φ	42	5'-6"	Str.			
521	do	4	4'-2"	Str.			
522	do	4	10'-0"	Str.			
523	do	8	17'-0"	Str.			
610	¾"φ	16	4'-3"	Str.			
611	do	6	8'-8"	IV	2'-0"	3'-4"	
612	do	2	47'-2"	Str.			
701	⅞"φ	24	11'-2"	Str.			
910	1⅛"φ	4	7'-10"	Str.			
911	do	4	13'-3"	Str.			
912	do	6	17'-0"	Str.			
1015	1¼"φ	4	9'-0"	Str.			
1016	do	4	12'-0"	Str.			
1017	do	2	9'-6"	Str.			
1018	do	2	15'-6"	Str.			
1019	do	4	47'-2"	Str.			

BAR SUMMARY ABUT. No. 5

A.E.S. / D.S.M.

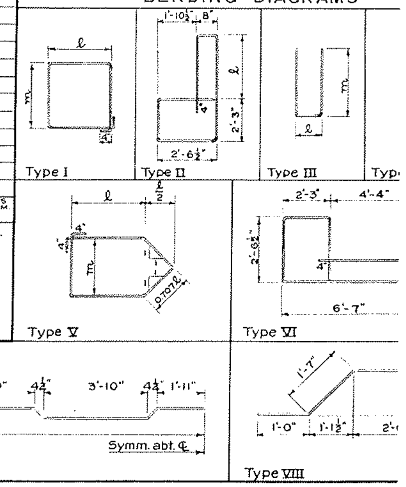
1687 Lin. Ft. ½"φ bar @ 0.668#/lin. ft. = 1127 lbs.
924 " " ⅝"φ " @ 1.043#/ " " = 442 "
214 " " ¾"φ " @ 1.502#/ " " = 321 "
268 " " ⅞"φ " @ 2.044#/ " " = 548 "
186 " " 1⅛"φ " @ 3.400#/ " " = 632 "
323 " " 1¼"φ " @ 4.303#/ " " = 1390 "
1% ± for Overrun = 45 "
Total = 4505 "



LIGHT STANDARD

Place 2 Light Standards on superstructure as shown on Sheet No. 8

* BENDING DIAGRAMS



* All bar dimensions are out to out of bar.

SUMMARY OF QUANTITIES

W.E.J. / A.E.S.

	ITEM	DESCRIPTION	UNIT	SUPERSTR.	ABUT. 1	PIER 2	PIER 3	PIER 4	ABUT. 5	TOTAL
	13 c	Unclassified Excavation	Cu. Yd.							
	14 a	Dry Rock Excavation (Str.)	Cu. Yd.							5
	14 b	Dry Common Excavation (Str.)	Cu. Yd.		9				12	21
	14 c	Wet Rock Excavation (Str.)	Cu. Yd.							5
	14 d	Wet Common Excavation (Str.)	Cu. Yd.		21	39	32	35	23	150
	16 a	Structure Backfill (Class 1)	Cu. Yd.		18	33	30	34	42	157
	16 c	Mechanical Tamping	Hour		14	3	4	4	12	37
	18 a	Sta. Yd. Overhaul	Sta. Yd.							
	18 b	Yd. Mi. Overhaul	Yd. Mi.							
	42 a	Untreated Bridge Timber	Mft. bm							.323
⊙	46 a	Class "A" Concrete	Cu. Yd.	222.4	35.8	31.8	31.8	31.8	40.4	394.0
	47	Reinforcing Steel	Lb.	34,025	3,900	4,365	4,365	4,365	4,505	55,525
†	48	Structural Steel (½% added for paint)	Lb.	200,184	578	268	268	268	578	202,144
	67 b	Heavy Riprap	Cu. Yd.							815
	80 c	Sheet Copper	Lb.			1.2	1.2	1.2		3.6
	89	Drain Pipe (Conc. Floor) 4"φ x 2'-0"	Each	8						8
	90	1½" Electrical Conduit with Junct. Boxes	Lin. Ft.	238						238
*		½" Expansion Joint Material	Sq. Ft.		4					4
*		¼" Expansion Joint Material	Sq. Ft.			30	30	30		90
	98 a	Light Standards complete with Base	Ea.	2						2
	98 c	Highway Luminaires	Ea.	2						2

⊙ Includes Class "A" Concrete Support for Lighting Standards.
† Includes 18,940 lbs. of Steel Handrailing.
* All Expansion Joint Material to be Type I, A.A.S.H.O., M 153-52 and to be included in the Bid Price for Class "A" Concrete.

GENERAL NOTES

ALL WORK SHALL BE DONE ACCORDING TO THE STANDARD SPECIFICATIONS OF THE COLORADO DEPARTMENT OF HIGHWAYS APPLICABLE TO THE PROJECT.

ALL CONCRETE SHALL BE CLASS "A" AND AIR ENTRAINED AS SPECIFIED.

ALL CONCRETE SURFACES EXPOSED TO VIEW SHALL RECEIVE CLASS "1" SURFACE FINISH, EXCEPT THE UNDERSIDE OF FLOOR SLABS AND ABUTMENT FACES BETWEEN OUTSIDE STRINGERS.

CONCRETE GIRDERS, FLOOR SLABS, AND CURBS SHALL BE POURED MONOLITHICALLY.

FORMS FOR CONCRETE SURFACES EXPOSED IN THE FINISHED WORK SHALL BE CONSTRUCTED OF SHIPLAP OR TONGUE AND GROOVE LUMBER S 2 S UNLESS FACED WITH PANEL BOARD.

FOOTINGS IN ROCK SHALL BE POURED OUT TO ROCK AND NOT FORMED.

SOUNDINGS AND DEPTH OF FOOTING SHOWN ARE IN ACCORDANCE WITH THE BEST AVAILABLE DATA AND WHEN DIFFERENT CONDITIONS ARE ENCOUNTERED THE BRIDGE ENGINEER WILL INSPECT AND DETERMINE IF REDESIGN IS NECESSARY.

ALL REINFORCING STEEL SHALL CONFORM TO ASTM SPECIFICATION A 305-50T OR THE LATEST REVISION THEREOF, AND SHALL BE INTERMEDIATE GRADE STEEL OF A DEFORMED TYPE. EACH BAR SHALL BE TAGGED WITH THE NUMBER DESIGNATION AND THE STATION NUMBER OF THE PROJECT. PRIMARY BARS SHALL NOT BE SPLICED AND SECONDARY BARS WHEN SPLICED SHALL LAP 20 DIAMETERS OF THE BAR. DIMENSIONS FOR REINFORCING STEEL NOT SHOWN AS CLEAR SHALL BE TO THE CENTER LINE OF THE BAR.

ALL STRUCTURAL STEEL SHALL BE PAINTED ONE SHOP COAT OF ZINC CHROMATE AND TWO FIELD COATS OF ALUMINUM, UNLESS OTHERWISE NOTED, EXCEPT THE UNEXPOSED PORTION OF STEEL PILING NEED NOT BE PAINTED.

HANDRAIL BOLTS SHALL HAVE HEX HEADS, NUTS AND LOCK WASHERS UNLESS OTHERWISE SPECIFIED AND ALL RIVETS EXCEPT AS NOTED ARE [illegible] DIA. AND SHALL BE POWER DRIVEN.

WHEN TREATED TIMBER OR PILING IS SHOWN ON THE DRAWING THE PRESERVATIVE FOR TREATMENT SHALL BE CREOSOTE OIL.

WHEN EXCAVATING FOR FOOTINGS THE FINAL ONE FOOT IN DEPTH SHALL BE DONE BY HAND LABOR METHODS.

HIGH STRENGTH BOLTS MAY BE USED IN PLACE OF FIELD RIVETS BUT AT NO ADDITIONAL EXPENSE TO THE STATE. THE BOLTS TO BE HIGH TENSILE AND SHALL BE ASSEMBLED IN ACCORDANCE WITH SPECIFICATIONS APPROVED BY THE RESEARCH COUNCIL ON RIVETED AND BOLTED STRUCTURAL JOINTS OF THE ENGINEERING FOUNDATION DATED JAN. 31, 1951.

STRUCTURE NO I-6-C

LOADING DATA

LIVE LOAD A.A.S.H.O. H-20-44
DEAD LOAD ASSUMES 15 LBS. PER SQ. FT. AD[illegible] SURFACE WHICH INCLUDES THE [illegible] INCH CON[illegible] WEARING SURFACE SHOWN

DESIGNING DATA

A.A.S.H.O. 1953 UNIT STRESSES, EXCEPT AS N[illegible]

Reinforcing Steel	fs	20000 lbs. per sq. in.
Structural Steel	fs	18000 lbs. per sq. in.
	fc	1000 lbs. per sq. in.
	n	10

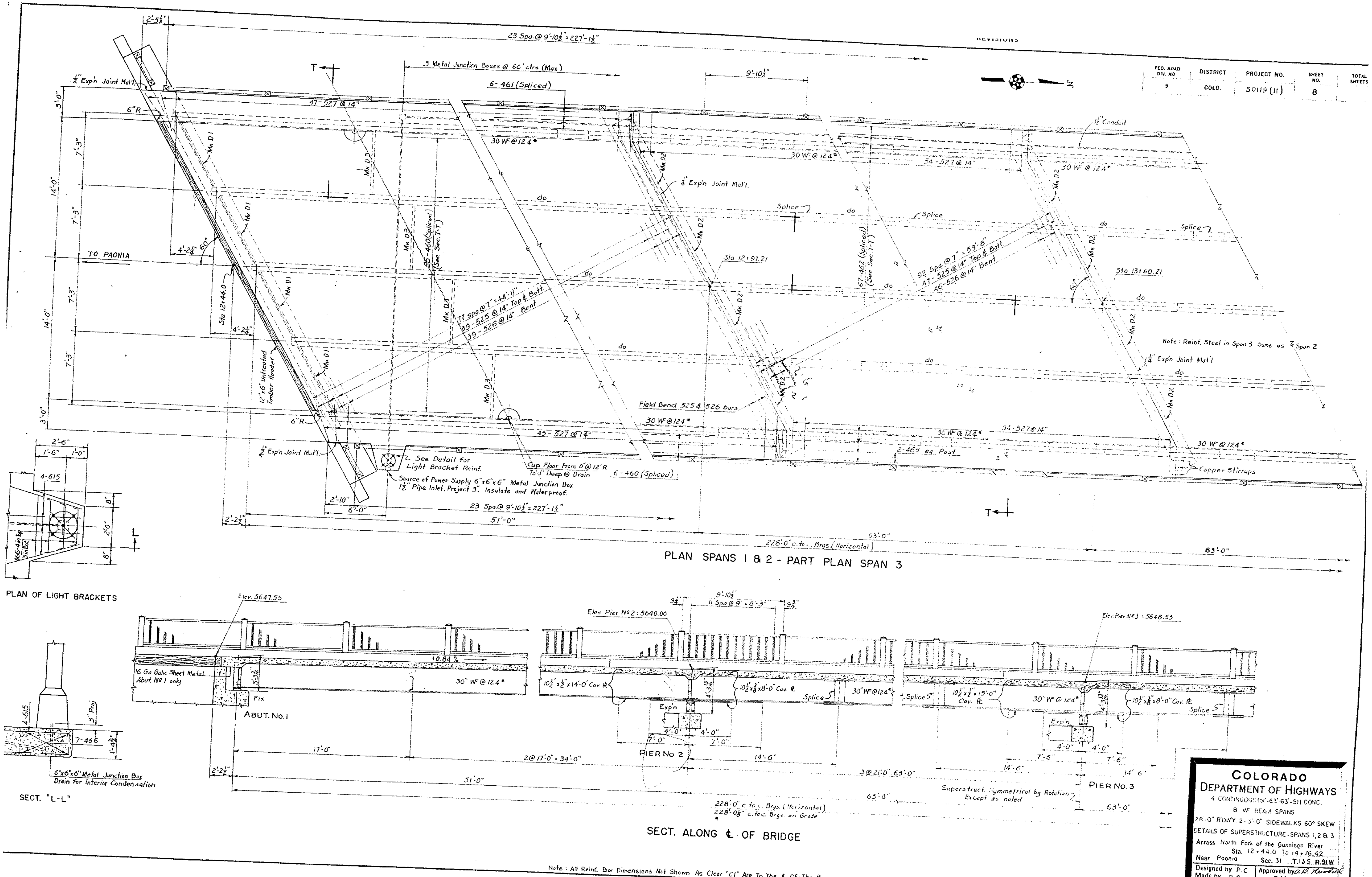
COLORADO
DEPARTMENT OF HIG[HWAYS]

4 CONTINUOUS (51', 63', 63' AND 51' ... AND WF BEAM SPANS, 60° SKEW, ... WAY, 2-3 FT. SIDEWALKS.
GENERAL LAYOUT, SUMMARY QUAN[TITIES], BAR LIST AND DETAILS.

Across North Fork of Gunnison F[...]
Sta. 12+44.0 TO 14+76.4[...]
Near Paonia Sec. 31 T. [...]

Designed by: P.C.	Approved by [signature]
Made by P.C.	Bridge Eng[ineer]
Checked by: T.J.M.	Date: [signature]

Initial	Date
P.C.	7-23-54
P.C.	7-23-54
T.J.M. / A.E.S.	8-21-54 / 10-29-54



STRUCTURE NO. I-6-C

COLORADO DEPARTMENT OF HIGHWAYS

4 CONTINUOUS (51'-63'-63'-51') CONC. & WF BEAM SPANS

28'-0" R'DWY 2-3'-0" SIDEWALKS 60° SKEW

DETAILS OF SUPERSTRUCTURE - SPANS 1, 2 & 3

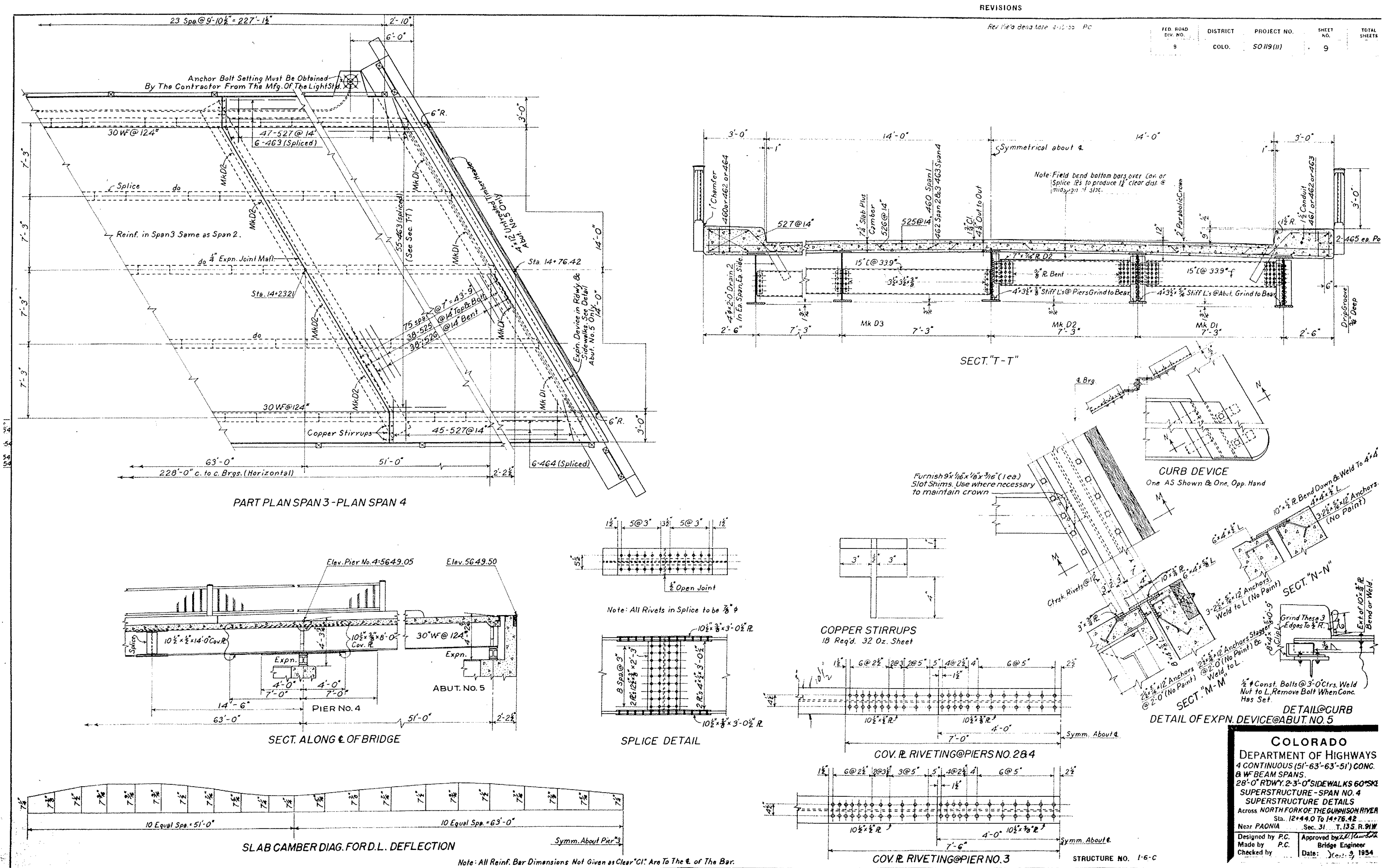
Across North Fork of the Gunnison River

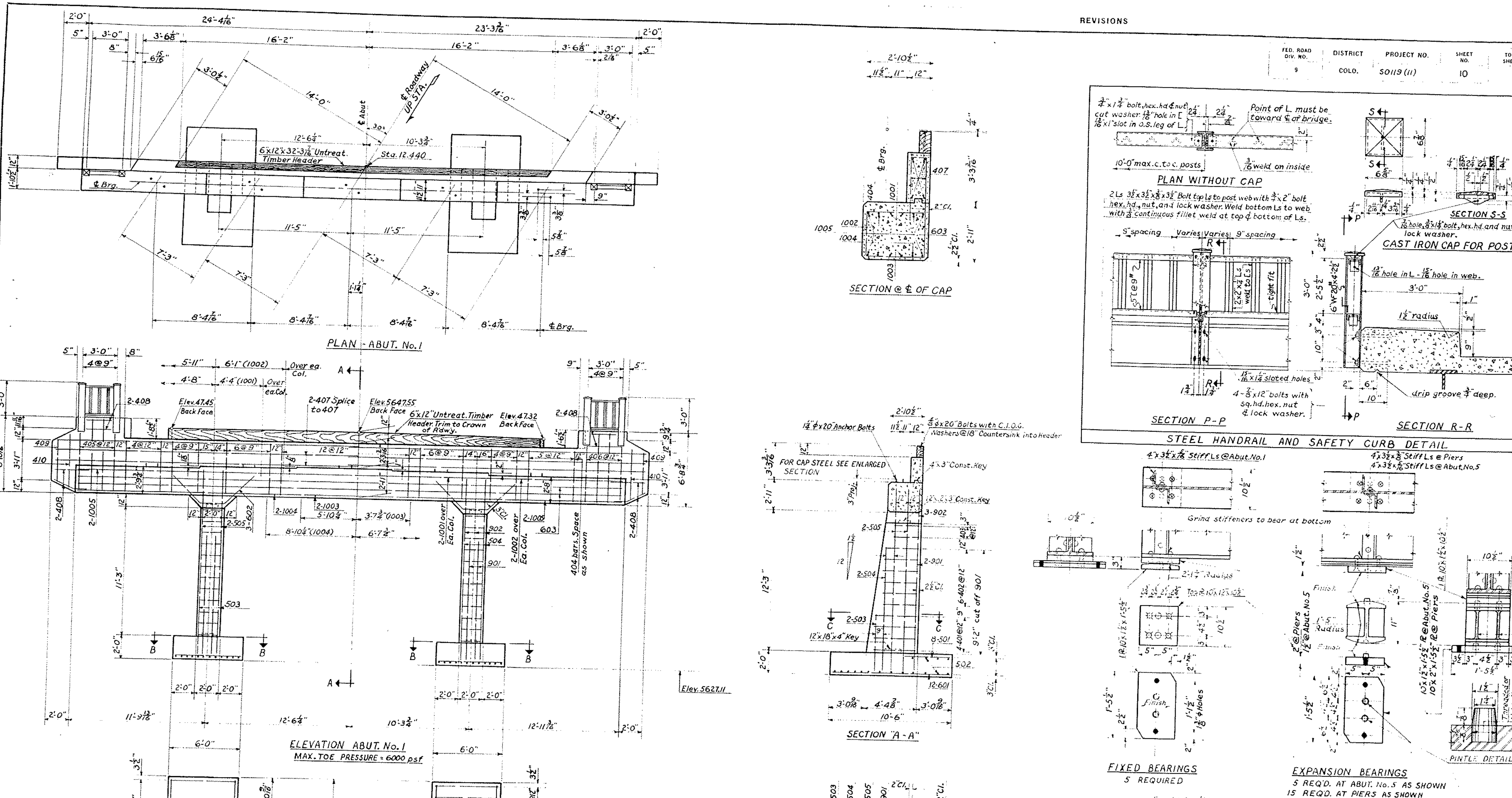
Sta. 12+44.0 to 14+76.42

Near Paonia — Sec. 31 T.13 S. R.91 W.

Designed by P.C.
Made by P.C.
Checked by

Approved by [signature] Bridge Engineer
Date: Nov. 3, 1954


REVISIONS
Rev. field bend note 4-11-55 PC
FED. ROAD DIV. NO. 9
DISTRICT COLO.
PROJECT NO. S0119(11)
SHEET NO. 9
TOTAL SHEETS
23 Spa.@ 9'-10½" = 227'-1½"
Anchor Bolt Setting Must Be Obtained By The Contractor From The Mfg. Of The Light Std.
30 WF@ 124#
47-527 @ 14"
6-463 (Spliced)
Reinf. in Span 3 Same as Span 2.
Splice
4" Expn. Joint Mat'l.
Sta. 14+23.21
Sta. 14+76.42
55-463 (spliced) (See Sec. T-T)
75 spa.@ 7" = 43'-9"
38-525 @ 14" Top & Bot.
38-526 @ 14" Bent
Expn. Device in R'dwy. & Sidewalks See Detail Abut. No. 5 Only
Copper Stirrups
45-527 @ 14"
6-464 (Spliced)
63'-0"
51'-0"
228'-0" c. to c. Brgs. (Horizontal)
PART PLAN SPAN 3 - PLAN SPAN 4
Symmetrical about ℄
Note: Field bend bottom bars over Cov. or Splice Pl's to produce 1½" clear dist. @ midspan of slab.
527 @ 14"
525 @ 14"
15" [@ 33.9#
4x3½x⅜ Stiff L's @ Piers Grind to Bear
4x3½x⅜ Stiff L's @ Abut. Grind to Bear
Mk D3
Mk D2
Mk D1
Drip Groove
SECT. "T-T"
Furnish 9"x1/16"x1/8"x3/16" (1 ea.) Slot Shims. Use where necessary to maintain crown
CURB DEVICE
One AS Shown & One, Opp. Hand
SECT. "N-N"
SECT. "M-M"
DETAIL @ CURB
DETAIL OF EXPN. DEVICE @ ABUT. NO. 5
Elev. Pier No. 4: 5649.05
Elev. 5649.50
PIER NO. 4
ABUT. NO. 5
SECT. ALONG ℄ OF BRIDGE
Note: All Rivets in Splice to be ⅞" ϕ
½" Open Joint
SPLICE DETAIL
COPPER STIRRUPS
18 Req'd. 32 Oz. Sheet
COV. PL. RIVETING @ PIERS NO. 2 & 4
COV. PL. RIVETING @ PIER NO. 3
Symm. About ℄
10 Equal Spa. = 51'-0"
10 Equal Spa. = 63'-0"
Symm. About Pier 3
SLAB CAMBER DIAG. FOR D.L. DEFLECTION
Note: All Reinf. Bar Dimensions Not Given as Clear "Cl." Are To The ℄ of The Bar.
STRUCTURE NO. I-6-C
COLORADO
DEPARTMENT OF HIGHWAYS
4 CONTINUOUS (51'-63'-63'-51') CONC. & WF BEAM SPANS.
28'-0" R'DW'Y. 2-3'-0" SIDEWALKS 60° SKEW
SUPERSTRUCTURE - SPAN NO. 4
SUPERSTRUCTURE DETAILS
Across NORTH FORK OF THE GUNNISON RIVER
Sta. 12+44.0 To 14+76.42
Near PAONIA Sec. 31 T. 13 S. R. 91 W
Designed by P.C.
Made by P.C.
Checked by
Approved by
Bridge Engineer
Date: 1954



FIXED BEARINGS
5 REQUIRED

Furnish 2 - 1 1/4" φ x 20" Anchor Bolts Per Brg.

EXPANSION BEARINGS
5 REQ'D. AT ABUT. No. 5 AS SHOWN
15 REQ'D. AT PIERS AS SHOWN

Coat Finished Contact Surfaces with Tallow & White Lead.

4 1/2" x 1/2" bars Weld all edges

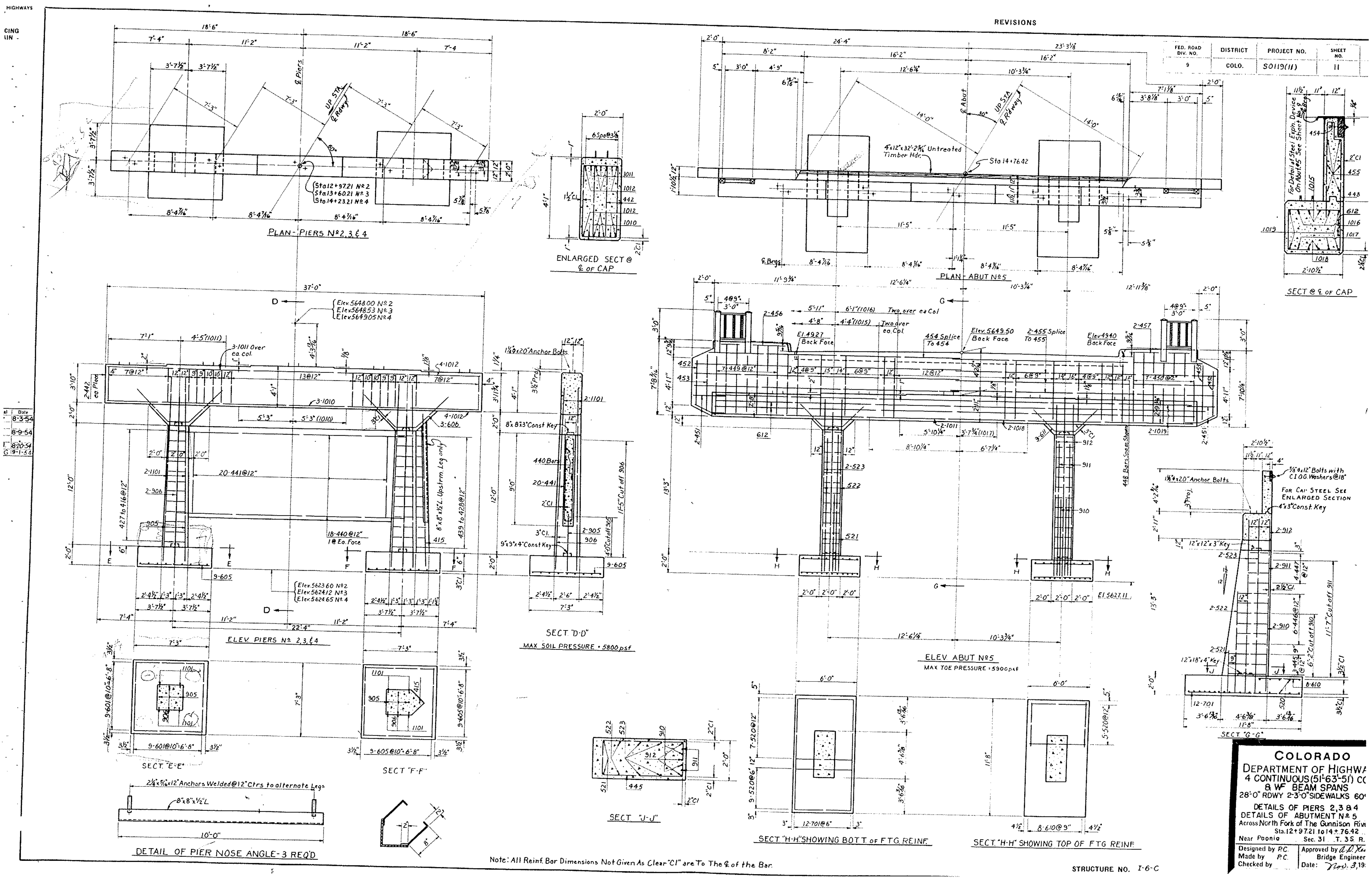
POURING SCHEDULE

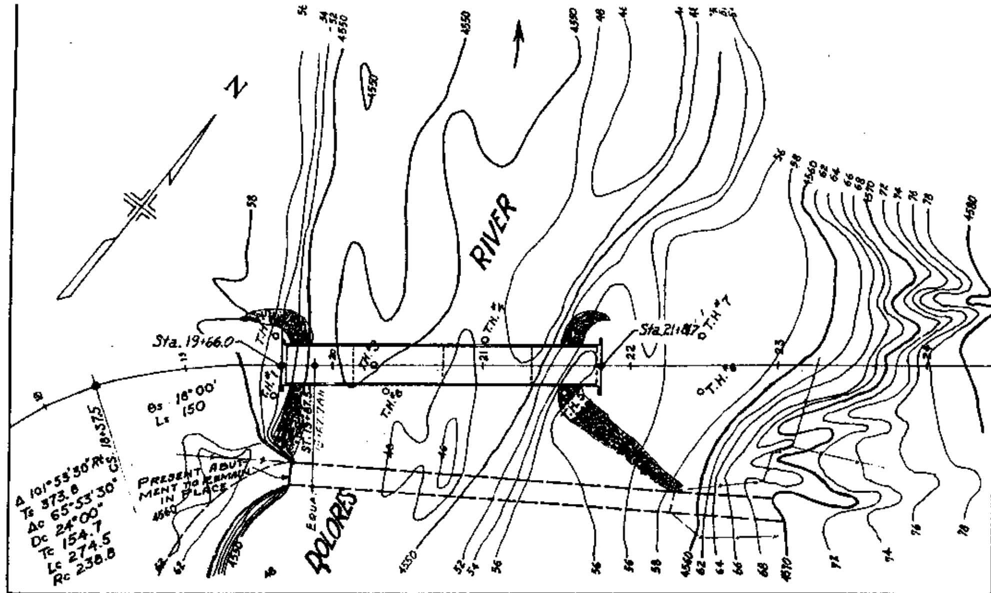
Description	Spans 1	Spans 2	Spans 3	Spans 4	Abuts. 1	Abuts. 5	Piers 2	Piers 3	Piers 4	Grand Total
Footings					9.4	10.4	7.8	7.8	7.8	
Columns & Web Wall					6.0	6.8	12.0	12.0	12.0	
Cap					15.4	15.1	12.0	12.0	12.0	
Parapet					5.0	8.1				
Total (Cu.Yd.)	51.0	60.2	60.2	51.0	35.8	40.4	31.8	31.8	31.8	394.0

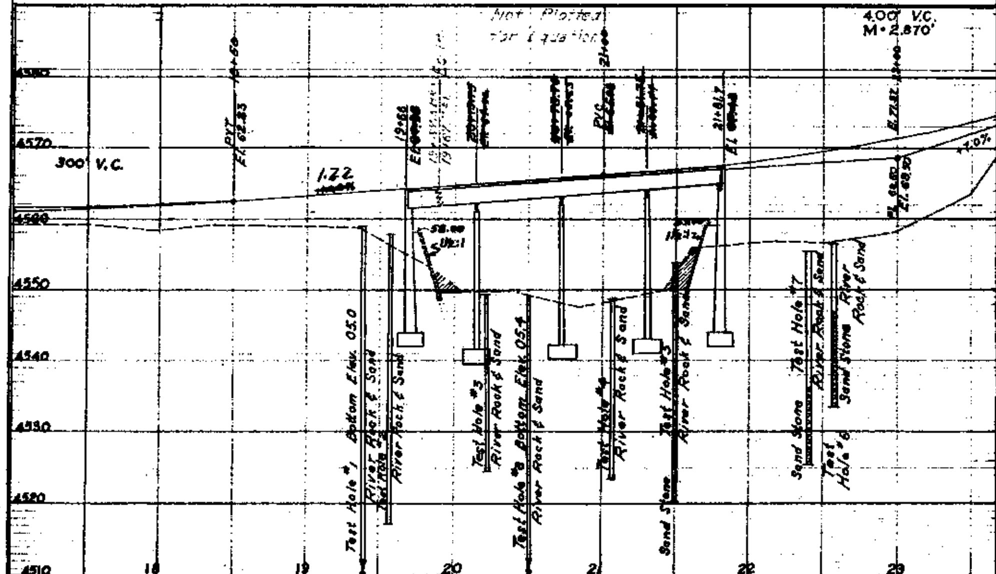
Note: All Reinf. Bar Dimensions Not Shown As Clear "Cl." Are To The ℄ Of The Bar.

COLORADO
DEPARTMENT OF HIGHWAYS
4 CONTINUOUS (51'-63'-63'-51') CONC. & WF BEAM SPANS
28'-0" RDWY. 2-3'-0" SIDEWALKS 60° SKEW
DETAILS OF ABUT. No. 1, HDRL. & BRGS.
Across North Fork of The Gunnison River
Sta. 12+44.0 to 14+76.42
Near Paonia Sec. 31 T.13S R.91W

Designed by P.C.
Made by P.C.
Checked by
Approved by [signature] Bridge Engineer
Date: 1954


REVISIONS
FED. ROAD DIV. NO. 9
DISTRICT COLO.
PROJECT NO. S0119(11)
SHEET NO. 11
PLAN - PIERS Nº 2, 3 & 4
Sta.12+97.21 Nº 2
Sta.13+60.21 Nº 3
Sta.14+23.21 Nº 4
ENLARGED SECT @ ℄ OF CAP
PLAN - ABUT Nº 5
4"x12"x32'-2⅝" Untreated Timber Hdr.
Sta 14+76.42
SECT @ ℄ OF CAP
For Detail of Steel Expn Device On Abut Nº 5 See Sheet Nº 9
Elev.5648.00 Nº 2
Elev.5648.53 Nº 3
Elev.5649.05 Nº 4
ELEV PIERS Nº 2, 3, & 4
Elev.5623.60 Nº 2
Elev.5624.12 Nº 3
Elev.5624.65 Nº 4
1⅛"x20" Anchor Bolts
8"x8"x3" Const Key
9"x3"x4" Const Key
8"x8"x½"L Upstrm Leg only
SECT "D-D"
MAX SOIL PRESSURE = 5800 psf
Elev.5649.50 Back Face
El.4927 Back Face
Elev.4940 Back Face
454 Splice To 454
2-455 Splice To 455
Two over ea Col
ELEV ABUT Nº 5
MAX TOE PRESSURE = 5900 psf
El.5627.11
1⅛"x20" Anchor Bolts
⅝"x12" Bolts with C.I.O.G. Washers @18"
FOR CAP STEEL SEE ENLARGED SECTION
4"x3" Const Key
12"x12"x3" Key
12"x18"x4" Key
SECT "G-G"
SECT "E-E"
SECT "F-F"
SECT "J-J"
SECT "H-H" SHOWING BOTT OF FTG REINF.
SECT "H-H" SHOWING TOP OF FTG REINF.
2¼"x5⅛"x12" Anchors Welded @12" Ctrs to alternate Legs
8"x8"x½"L
DETAIL OF PIER NOSE ANGLE - 3 REQ'D
Note: All Reinf. Bar Dimensions Not Given As Clear "Cl" are To The ℄ of the Bar.
STRUCTURE NO. I-6-C
COLORADO
DEPARTMENT OF HIGHWA
4 CONTINUOUS (51'-63'-51') C
8 WF BEAM SPANS
28'-0" RDWY 2-3'-0" SIDEWALKS 60
DETAILS OF PIERS 2, 3 & 4
DETAILS OF ABUTMENT Nº 5
Across North Fork of The Gunnison Riv
Sta.12+97.21 to 14+76.42
Near Paonia Sec. 31 T. 3S R.
Designed by P.C.
Made by P.C.
Checked by
Approved by
Bridge Engineer
Date: Nov. 3, 19





BAR LIST ABUT. #1						
No.	Size	No. Req'd	Length	Type	Dimension a	Dimension b
460	#4	12	5'-6"	Str.		
461	"	4	17'-0"	VII	6'-0"	4'-4"
462	"	48	14'-1"	VII	4'-6½"	2'-4½"
463	"	Not Used.				
464	"	4	7'-3"		Field bend	
465	"	4	3'-9"	Str.		
466	"	14	8'-4"	IX	2'-2"	1'-8"
467	"	16	10'-8"	IX	3'-4"	1'-8"
469	"	18	7'-0"	Str.		
471	"	6	5'-0"	Str.		
472	"	Not Used.				
473	"	6	35'-6"	Str.		
561	#5	14	5'-6"	Str.		
661	#6	8	5'-6"	Str.		
662	"	6	10'-0"	VI		
760	#7	24	3'-9"	Str.		
762	"	4	12'-0"	Str.		
763	"	4	6'-0"	Str.		
764	"	10	16'-6"	Str.		
766	"	6	8'-9	Str.		
768	"	16	9'-0"	Str.		
861	#8	8	33'-6"	Str.		
862	"	3	13'-6"	Str.		
863	"	6	9'-0"	Str.		

BAR LIST ABUT. #5						
No.	Size	No. Req'd	Length	Type	Dimension a	Dimension b
440	#4	12	5'-6"	Str.		
441	"	6	18'-10"	VII	6'-11"	6'-3"
442	"	44	17'-4"	VIII	6'-2"	4'-6"
443	"	4	5'-9"	Str.		
444	"	4	5'-3"	Str.		
445	"	4	4'-9"	—	Field bend	
446	"	16	8'-4"	IX	2'-2"	1'-8"
447	"	16	11'-0"	IX	3'-6"	1'-8"
449	"	18	7'-6"	Str.		
451	"	6	5'-0"	Str.		
452	"	2	30'-0"	Str.		
453	"	8	33'-6"	Str.		
541	#5	14	5'-6"	Str.		
641	#6	12	5'-6"	Str.		
642	"	6	10'-0"	VI	4'-0"	2'-0"
741	#7	20	10'-6"	Str.		
840	#8	24	3'-9"	Str.		
841	"	8	33'-6"	Str.		
842	"	3	14'-0"	Str.		
843	"	6	9'-0"	Str.		
844	"	6	8'-9"	Str.		
846	"	10	18'-8"	Str.		
847	"	4	11'-9"	Str.		
848	"	4	6'-0"	Str.		

FED ROAD DIV. NO.	STATE	PROJ. NO.	SHEET NO.
9	COLO.	A-AA 23(1)	4

SUMMARY OF QUANTITIES

Item No.	Description	Unit	Super-Structure	Abut. 1	Pier 2	Pier 3	Pier 4	Abut. 5
1a	Removal of Existing Bridge	Lump Sum	—	—	—	—	—	—
13c	Unclassified Excavation	Cu. Yd.	—	83	—	—	—	27
14g	Common Excavation (Str.)	Cu. Yd.	—	43	27	21	23	48
16a	Structure Backfill (Class 1)	Cu. Yd.	—	43	27	21	23	48
16c	Mechanical Tamping	Hour	—	15	4	3	3	18
18a	Station Yard Overhaul	Sta. Yd.						
42b	Treated Bridge Timber	M.ft. bm.	0.288	0.096	0	0	0	.09
46a	Class "A" Concrete	Cu. Yd.	170	27	26	26	26	32
47	Reinforcing Steel (+1% for Overrun)	Lb.	25,180	3310	3,825	3825	3,825	400
48 +	Structural Steel (+½% for Paint)	Lb.	159,793	20	364	364	364	2
67a	Riprap	Cu. Yd.	0	65	0	0	0	95
75cx	Metal Plate Guard Rail (Beam Type)	Lin. Ft.	514	—	—	—	—	—
89a	Drain Pipe (Conc. Floor) (4"⌀ x 1'-6")	Each	8	—	—	—	—	—
*	½" Expansion Joint Mat'l. (Type I)	Sq. Ft.	0	4	16	16	16	0

\+ Structural Steel includes 4738 lbs Handrail Steel.
* Expansion Joint Material shall be included in the price bid for Class "A" Concrete and shall conform to A.A.S.H.O. Specification M-153-54

BAR LIST PIER No. 2 (PIER 3 & 4 Same)						
No.	Size	No. Req'd	Length	Type	Dimension a	Dimension b
421	#4	1	3'-9"	dowel		
422	"	1	18'-6"	Str.		
423	"	32	14'-0"	Str.		
424	"	30	15'-0"	Str.		
425	"	6	8'-8"	III		
426	"	36	7'-9"	IX	1'-9"	1'-9"
427	"	82	7'-9"	IX	1'-2½"	2'-4½"
721	#7	28	6'-0"	Str.		
826	#8	4	27'-6"	Str.		
827	"	4	12'-0"	Str.		
921	#9	16	3'-9"	dowel		
922	"	8	18'-9"	Str.		
923	"	8	14'-2"	Str.		
925	"	8	8'-5"	Str.		
926	"	4	27'-6"	Str.		

BAR LIST SUPERSTRUCT.						
No.	Size	No. Req'd	Length	Type	Dimension a	Dimension b
401	#4	57	28'-6"	Str.		
402	"	114	38'-6"	Str.		
403	"	57	38'-6"	Str.		
404	"	228	20'-0"	Str.		
405	"	284	3'-7"	II		
406	"	144	1'-0"	Str.		
501	#5	160	27'-9"	I		
502	"	320	26'-6"	Str.		

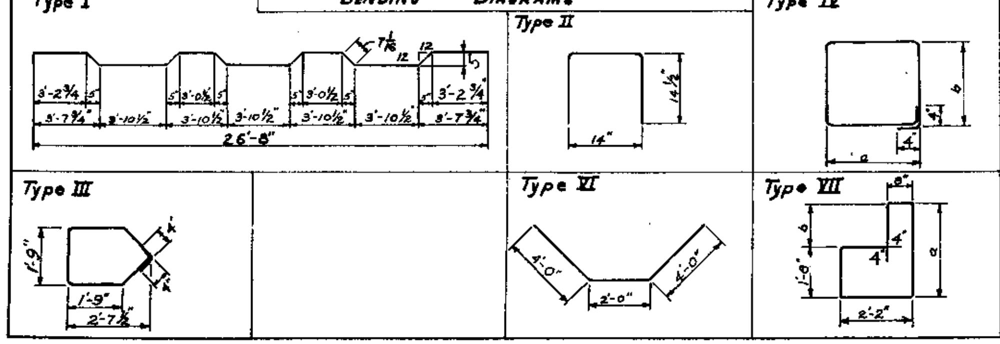
BAR SUMMARY ABUT. #1			
Size	Lin. ft.	lbs/ft.	lbs
#4	1498	0.668	1000
5	77	1.043	80
6	104	1.502	156
7	524	2.044	1071
8	363	2.670	969
9	—	—	—
		Subtotal	3277
+1% for overrun			32
		TOTAL	3310

BAR SUMMARY ABUT. #5			
Size	Lin. ft.	lbs/ft.	lbs
#4	1829	0.668	1222
5	77	1.043	80
6	126	1.502	189
7	210	2.044	429
8	765	2.670	2043
9	—	—	—
		Subtotal	3963
+1% for overrun.			37
		TOTAL	4000

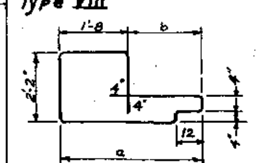
BAR SUMMARY PIER 2 (PIERS 3 & 4)			
Size	Lin. ft.	lbs/ft.	lbs
#4	1971	0.668	1317
5	—	—	—
6	—	—	—
7	168	2.044	343
8	158	2.670	422
9	501	3.400	1,703
		Subtotal	3785
+1% for overrun			40
		TOTAL	3825

BAR SUMMARY SUPERSTRUCTURE			
Size	Lin. ft.	lbs/ft.	lbs
4	13,900	0.668	9,285
5	12,920	1.043	13,476
6	—	—	—
7	—	—	—
8	—	—	—
9	—	—	—
		Subtotal	22,761
+1% for overrun			229
		TOTAL	22,990

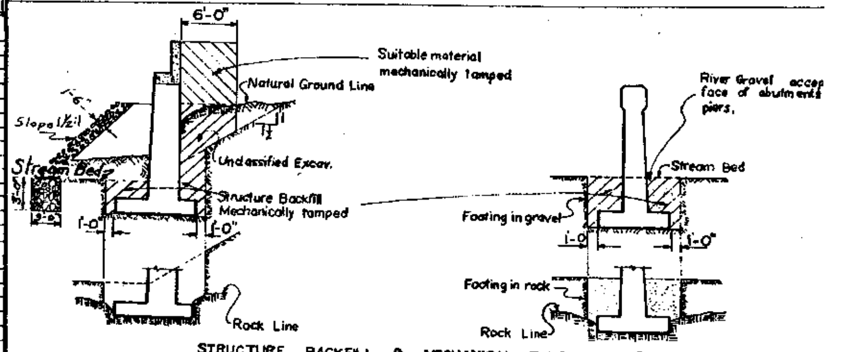
BENDING DIAGRAMS



Type VIII



Note:
All dimensions for bent bars are out to out of bars.



STRUCTURE BACKFILL & MECHANICAL TAMPING DIAGRAM

GENERAL NOTES

All work shall be done according to the standard specifications of The Colorado Department of Highways applicable
All concrete shall be class "A" and air entrained as Specified.
All concrete surfaces exposed to view shall receive class "1" surface finish, except the underside of floor slabs faces between outside stringers..
Forms for concrete surfaces exposed in the finished work shall be constructed of shiplap or tongue and groove lumber faced with panel board.
Footings in rock shall be poured out to rock and not formed.
Soundings and depth of footing shown are in accordance with the best available data and when different conditions a the bridge engineer will inspect and determine if redesign is necessary.
All reinforcing steel shall conform to ASTM specification A 305-50T or the latest revision thereof, and shall grade steel of a deformed type. Each bar shall be tagged with the number designation and the station numb set. Primary bars shall not be spliced and secondary bars when spliced shall lap 20 diameters of the bar. Dime reinforcing steel not shown as clear shall be to the center line of the bar.
All structural steel shall be painted one shop coat of zinc chromate and two field coats of aluminum, unless except the unexposed portion of steel piling need not be painted.
Handrail bolts shall have hex. heads, nuts and lock washers unless otherwise specified and all rivets, ex are ¾" dia. and shall be power driven.
When treated timber or piling is shown on the drawing the preservative for treatment shall be creosote
When excavating for footings the final one foot in depth shall be done by hand labor methods.
High tensile strength bolts may be substituted for field rivits but at no additional expense to the state. The bolts shall be assembled in accordance with specifications approved by research council on riveted and bolted structural joints of the engineering foundation Jan. 31, 1951.

DESIGNING DATA:
A.A.S.H.O. 1953 unit stresses, except as noted. 33 KSI
Reinforcing Steel; fs = 20,000 psi, Structural Steel: fs = 18,000 psi, fc = 1,200 psi; n = 10 40 KSI 3.0 KSI

LOADING DATA:
Live Load - A.A.S.H.O. (H20-S16). Dead Load:- assumes 15 lbs. per sq. ft. additional wearing surface which includes the ½ inch concrete monolithic wearing surface shown.

Prepared by: THE BRODERICK ENGINEERING CO.

Thomas A. Broderick

Thomas A. Broderick
Registered Engineer No. 1763

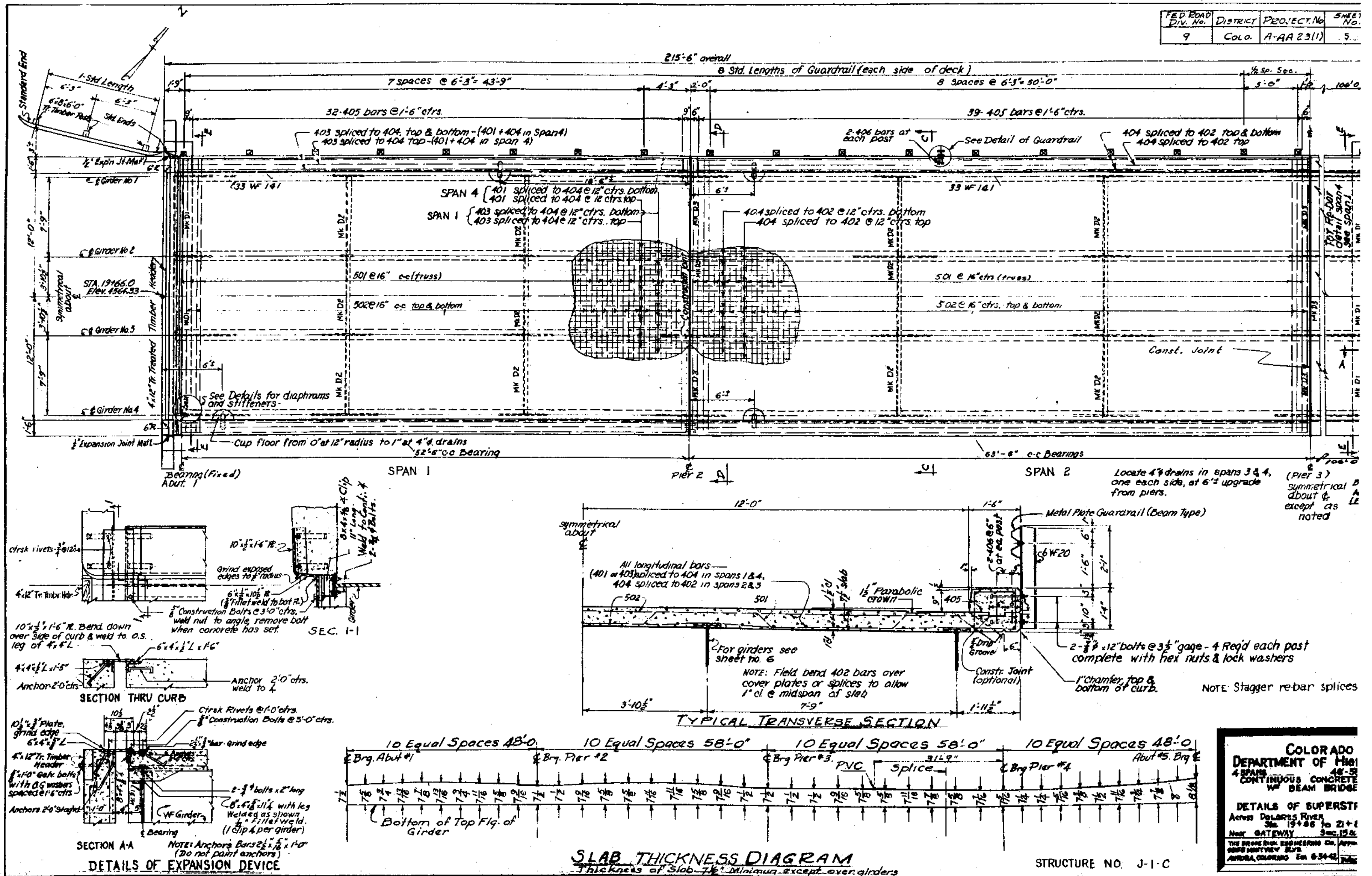
STRUCTURE NO. J-1-C

COLORADO
DEPARTMENT OF HIGH
4 SPANS 48-58-58-48 CONC AND CONTINUOUS WF BEAM 1'-6" SAFETY CURB
GENERAL LAYO

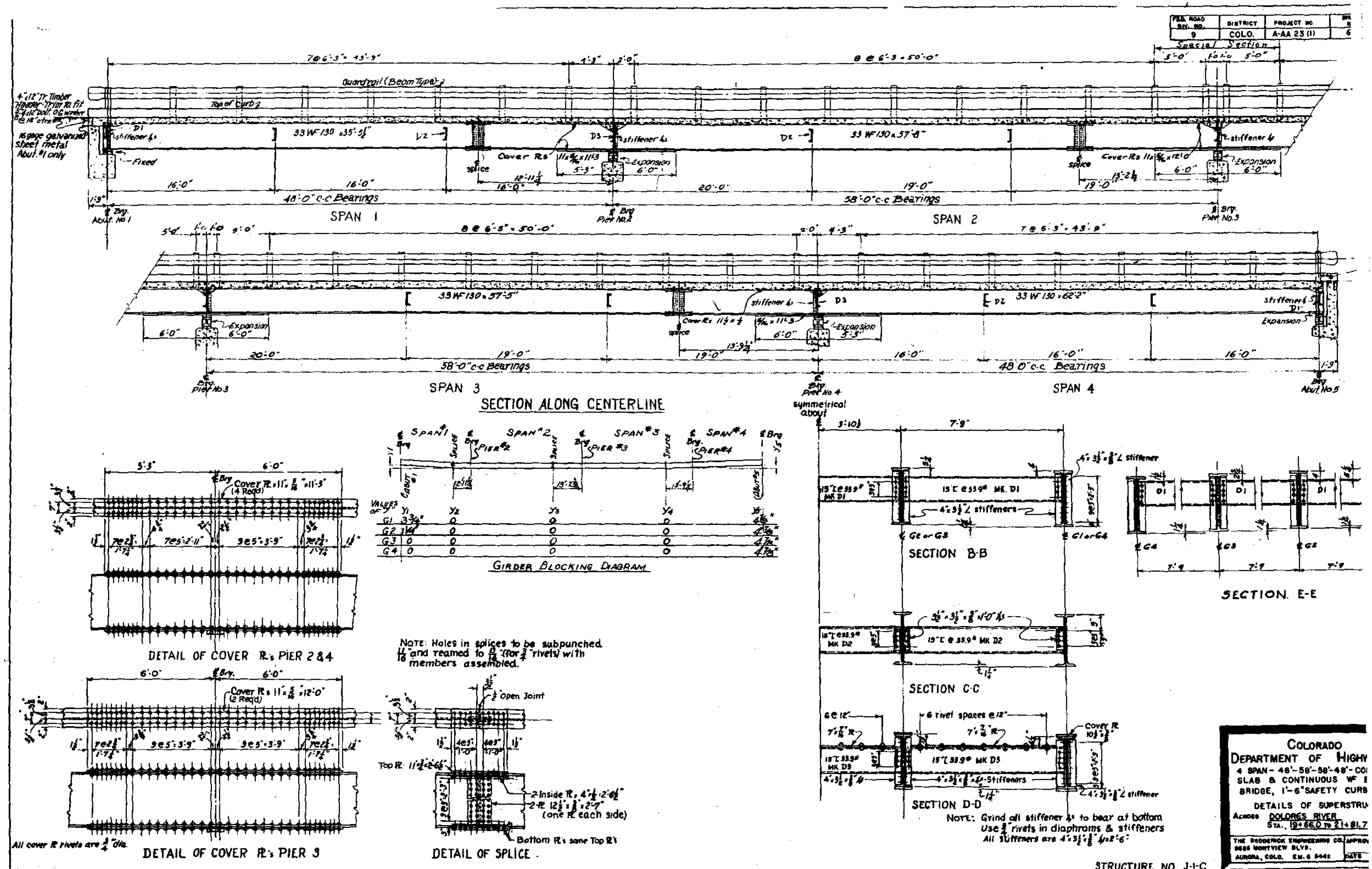
Across Dolores River
Sta. 19+66.00 to 21+81.7
Near Gateway Sec. 22 T. 5

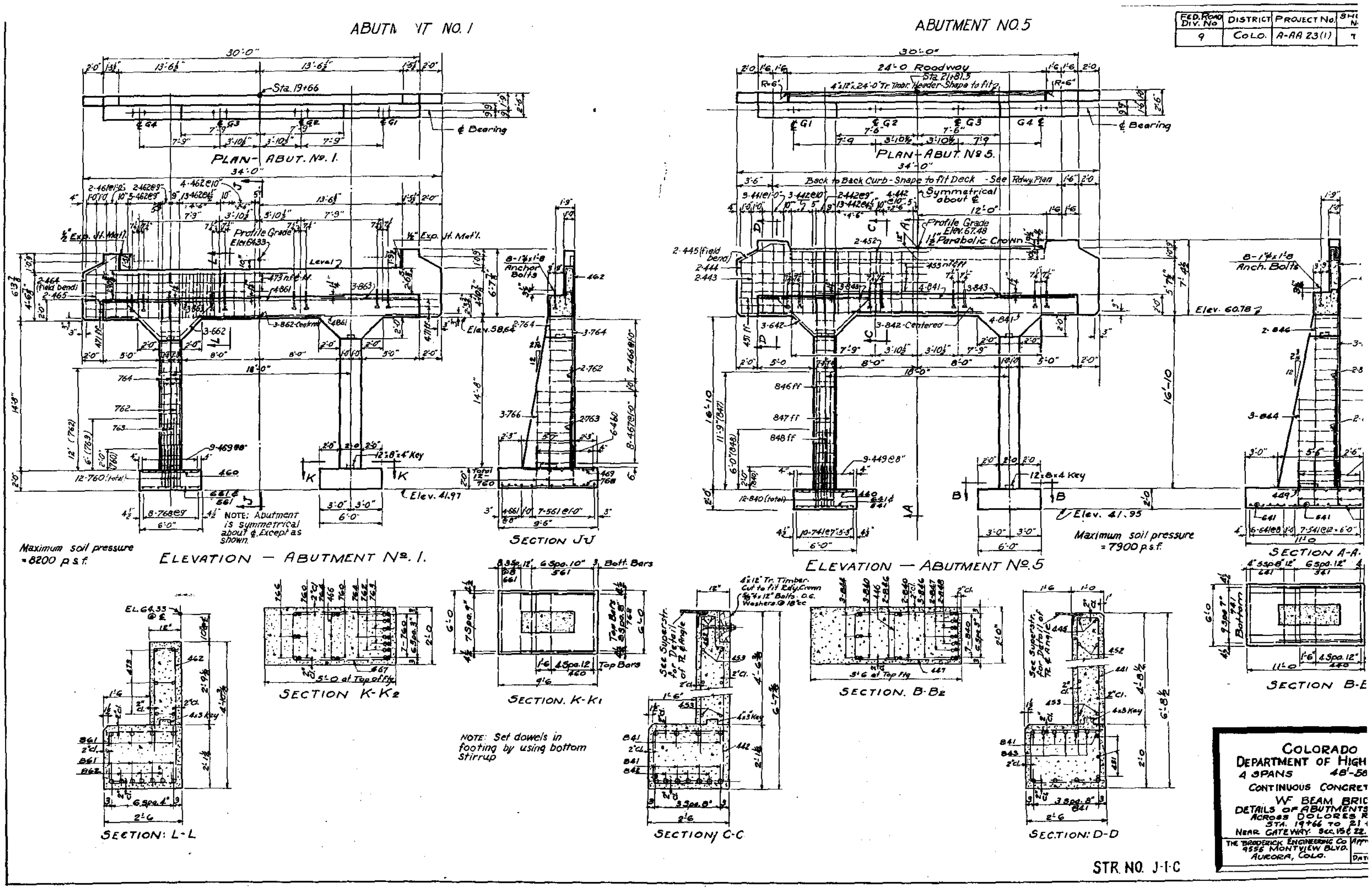
THE BRODERICK ENGINEERING CO.
9555 MONTVIEW BLVD.
AURORA, COLORADO Em 6-5442

Yr. Construction: '57



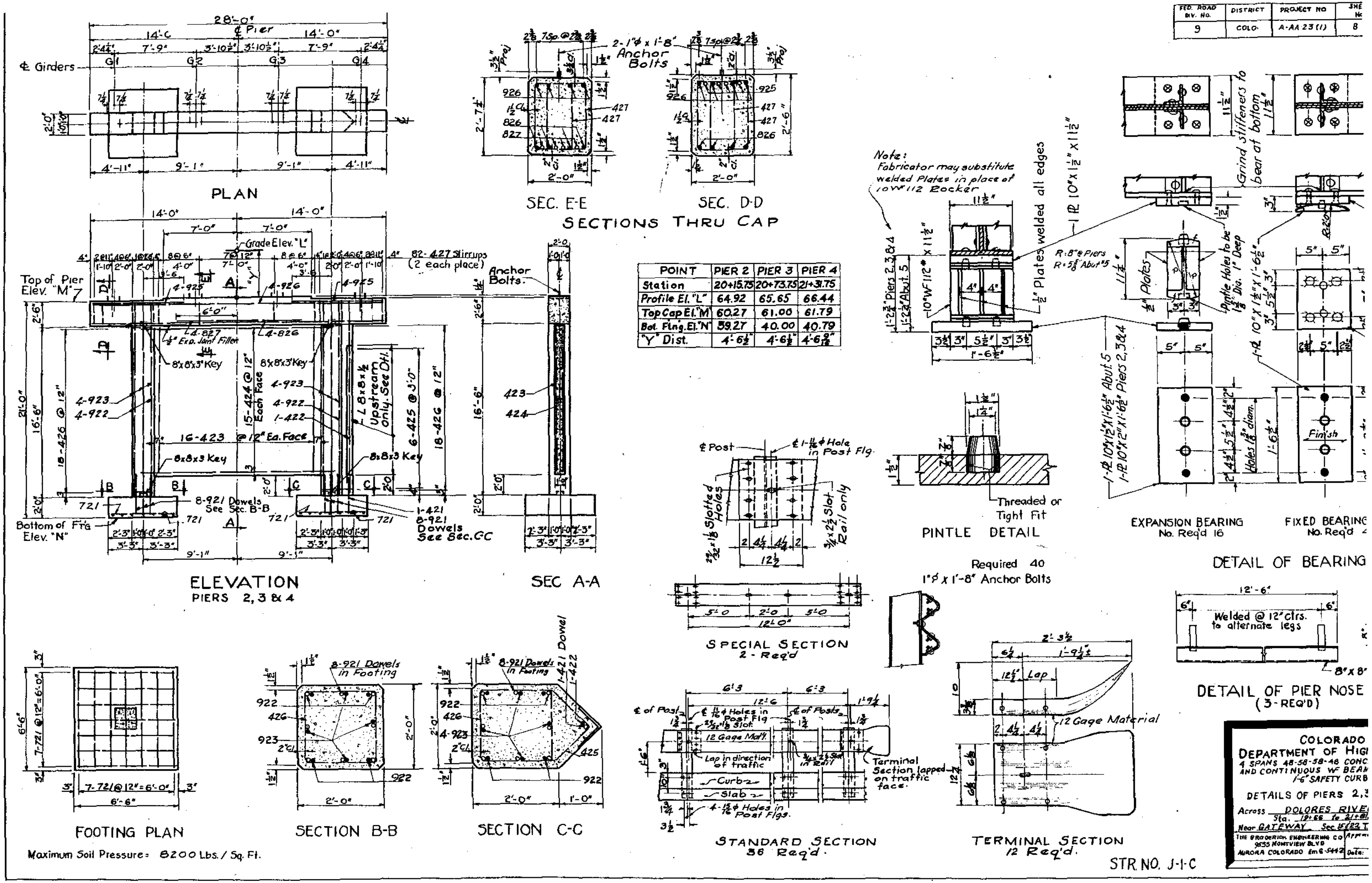
FED ROAD DIV. No. | DISTRICT | PROJECT No. | SHEET No.
9 | COLO. | A-AA 23(1) | 5
215'-6" overall
8 Std. Lengths of Guardrail (each side of deck)
7 spaces @ 6'-3" = 43'-9"
8 spaces @ 6'-3" = 50'-0"
32-405 bars @ 1'-6" ctrs.
39-405 bars @ 1'-6" ctrs.
403 spliced to 404, top & bottom - (401 + 404 in Span 4)
403 spliced to 404 top - (401 + 404 in span 4)
2-406 bars at each post
See Detail of Guardrail
404 spliced to 402 top & bottom
404 spliced to 402 top
1-Std Length
Standard End
Std Ends
Tr. Timber Posts
½" Expn Jt Mat'l
Girder No 1
Girder No 2
Girder No 3
Girder No 4
33 WF 141
SPAN 4 {401 spliced to 404 @ 12" ctrs. bottom / 401 spliced to 404 @ 12 ctrs. top}
SPAN 1 {403 spliced to 404 @ 12" ctrs. bottom / 403 spliced to 404 @ 12" ctrs. top}
404 spliced to 402 @ 12" ctrs. bottom
404 spliced to 402 @ 12 ctrs. top
STA. 19+66.0 Elev. 4564.33
Symmetrical about ℄
4"x12" Tr. Treated Timber Header
501 @ 16" c-c (truss)
502 @ 16" c-c top & bottom
501 @ 16" ctrs (truss)
502 @ 16" ctrs. top & bottom
Construction Joint
Const. Joint
For Re-bar detail span 4 see span 1
See Details for diaphrams and stiffeners
Cup floor from 0" at 12" radius to 1" at 4" ∅ drains
52'-6" c-c Bearing
63'-6" c-c Bearings
½" Expansion Joint Mat'l
Bearing (Fixed) Abut. 1
SPAN 1
Pier 2
SPAN 2
(Pier 3)
Locate 4" ∅ drains in spans 3 & 4, one each side, at 6'± upgrade from piers.
Symmetrical about ℄ except as noted
Metal Plate Guardrail (Beam Type)
symmetrical about ℄
All longitudinal bars — (401 or 403) spliced to 404 in spans 1 & 4, 404 spliced to 402 in spans 2 & 3
1½" Parabolic crown
6 WF 20
2-406 bars at ea. post
For girders see sheet no. 6
NOTE: Field bend 402 bars over cover plates or splices to allow 1" cl. @ midspan of slab
Drip Groove
Constr. Joint (optional)
2-⅝" ∅ x 12" bolts @ 3½" gage - 4 Req'd each post complete with hex nuts & lock washers
1" Chamfer, top & bottom of curb.
NOTE: Stagger re-bar splices
12'-0"
3'-10½"
7'-9"
1'-11½"
TYPICAL TRANSVERSE SECTION
ctrsk rivets ⅝" @ 12"
4"x12" Tr. Timbr. Hdr.
10"x½"x1'-6" R. Bend down over side of curb & weld to O.S. leg of 4"x4" L
6"x4"x½" L x 1'-6"
4"x4"x½" L x 1'-5"
Anchor 2'-0" ctrs.
Anchor 2'-0" ctrs. weld to L
SECTION THRU CURB
10"x½"x1'-6" R.
Grind exposed edges to ⅛" radius
6"x¾"x10½" R. (⅜" Fillet weld to bot R.)
⅝" Construction Bolts @ 3'-0" ctrs. weld nut to angle, remove bolt when concrete has set.
8x4x⅝ L Clip 11" long Weld to Girder
SEC. 1-1
10½"x⅜" Plate, grind edge
6"x4"x⅜" L
4"x12" Tr. Timber Header
⅝"x1'-0" Galv. bolts with O.G. washers spaced @ 6" ctrs.
Anchors 2'-0" Stag'd
Ctrsk Rivets @ 1'-0" ctrs.
⅝" Construction Bolts @ 3'-0" ctrs.
2½"x¾" bar - grind edge
2-¾" ∅ bolts x 2" long
8"x4"x⅝" x 11¼" with leg welded as shown ¼" Fillet weld. (1 clip & per girder)
WF Girder
Bearing
SECTION A-A
NOTE: Anchors Bars 2¼" x ⅝" x 1'-0" (Do not paint anchors)
DETAILS OF EXPANSION DEVICE
10 Equal Spaces 48'-0
10 Equal Spaces 58'-0"
10 Equal Spaces 58'-0"
10 Equal Spaces 48'-0
℄ Brg. Abut #1
℄ Brg. Pier #2
℄ Brg. Pier #3
℄ Brg. Pier #4
Abut #5 Brg ℄
PVC
Splice
31'-9"
Bottom of Top Flg. of Girder
SLAB THICKNESS DIAGRAM
Thickness of Slab - 7½" Minimum except over girders
STRUCTURE NO. J-1-C
COLORADO
DEPARTMENT OF HI…
4 SPANS 48'-5…
CONTINUOUS CONCRETE…
WF BEAM BRIDGE
DETAILS OF SUPERSTR…
Across DOLORES RIVER
Sta. 19+66 to 21+…
Near GATEWAY
THE BROOK RICK ENGINEERING CO.
AURORA, COLORADO


FED. ROAD DIV. NO. 9
DISTRICT COLO.
PROJECT NO. A-AA 23 (1)
Special Section
7 @ 6'-3" = 43'-9"
8 @ 6'-3" = 50'-0"
Guardrail (Beam Type)
Top of Curb
4"x12" Tr. Timber Header - Trim to fit
16 gage galvanized sheet metal Abut. #1 only
33 WF 130 x 35'-5½"
33 WF 130 x 57'-8"
stiffener
Fixed
splice
Cover R's
Expansion 6'-0"
48'-0" c-c Bearings
58'-0" c-c Bearings
℄ Brg. Abut. No 1
℄ Brg. Pier No. 2
℄ Brg. Pier No. 3
SPAN 1
SPAN 2
33 WF 130 x 57'-5"
33 WF 130 x 62'-2"
Expansion
58'-0" c-c Bearings
48'-0" c-c Bearings
℄ Brg. Pier No 3
℄ Brg. Pier No. 4
℄ Brg. Abut. No 5
SPAN 3
SPAN 4
SECTION ALONG CENTERLINE
symmetrical about
GIRDER BLOCKING DIAGRAM
SECTION B-B
15" [@ 33.9# MK. D1
4"x3½" ∠ stiffeners
4"x3½"x⅜" ∠ stiffener
SECTION E-E
SECTION C-C
15" [@ 33.9# MK D2
SECTION D-D
15" [33.9# MK D3
6 rivet spaces @ 12"
NOTE: Holes in splices to be subpunched 11/16" and reamed to 13/16" (for ¾" rivets) with members assembled.
DETAIL OF COVER R's PIER 2 & 4
Cover R's 11" x 5/16" x 11'-3" (4 Reqd)
DETAIL OF COVER R's PIER 3
Cover R's 11" x 5/16" x 12'-0" (2 Reqd)
All cover R rivets are ¾" dia.
DETAIL OF SPLICE
½" Open Joint
2-Inside R, 4"x½"x2'-6½"
2-R 12½"x⅜"x2'-7" (one R each side)
Bottom R's same Top R's
NOTE: Grind all stiffener ℄'s to bear at bottom. Use ¾" rivets in diaphragms & stiffeners. All stiffeners are 4"x3½"x⅜" ∠s x 2'-6"
STRUCTURE NO. J-1-C
COLORADO DEPARTMENT OF HIGHWAYS
4 SPAN - 48'-58'-58'-48' - CONCRETE SLAB & CONTINUOUS WF BEAM BRIDGE, 1'-6" SAFETY CURB
DETAILS OF SUPERSTRUCTURE
Across DOLORES RIVER
STA. 19+66.0 to 21+81.7
THE BRODERICK ENGINEERING CO. 9865 MONTVIEW BLVD. AURORA, COLO.



FED. ROAD DIV. No | DISTRICT | PROJECT No.
9 | COLO. | A-AA 23(1)
ABUTMENT NO. 1
ABUTMENT NO. 5
PLAN - ABUT. No. 1.
PLAN - ABUT. No 5.
Sta. 19+66
Sta. 21+81.3
24'-0 Roadway
4"x12"x24'-0" Tr. Timb. Header Shape to fit
Back to Back Curb - Shape to fit Deck - See Rdwy. Plan
Symmetrical about ℄
℄ Bearing
Profile Grade Elev. 64.33
Profile Grade Elev. 67.48
1½" Parabolic Crown
½" Exp. Jt. Mat'l.
8-1⅛"x1'-8 Anchor Bolts
Elev. 58.64
Elev. 60.78
Elev. 41.97
Elev. 41.95
12"x8"x4" Key
12x8x4 Key
NOTE: Abutment is symmetrical about ℄ Except as shown.
Maximum soil pressure = 8200 p.s.f.
Maximum soil pressure = 7900 p.s.f.
ELEVATION - ABUTMENT No. 1.
ELEVATION - ABUTMENT No. 5
SECTION J-J
SECTION A-A
SECTION L-L
SECTION K-K2
SECTION. K-K1
SECTION C-C
SECTION. B-B2
SECTION: D-D
SECTION B-B
NOTE: Set dowels in footing by using bottom stirrup
4"x12" Tr. Timber Cut to fit Rdy. Crown
See Superstr. for Detail of Pl. & Angle
COLORADO
DEPARTMENT OF HIGH
4 SPANS 48'-58
CONTINUOUS CONCRET
WF BEAM BRIC
DETAILS OF ABUTMENTS
ACROSS DOLORES R
STA. 19+66 TO 21
NEAR GATEWAY Sec. 15 & 22
THE BRODERICK ENGINEERING CO.
4556 MONTVIEW BLVD.
AURORA, COLO.
STR. NO. J-1-C

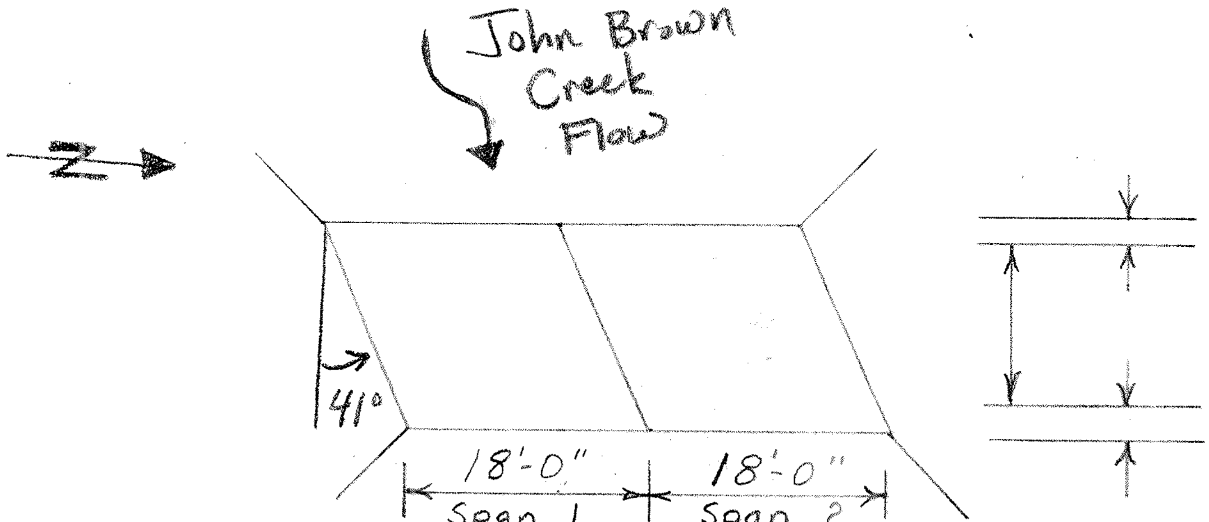
FED. ROAD DIV. NO.	DISTRICT	PROJECT NO.	SHE... No.
9	COLO.	A-AA 23 (1)	8

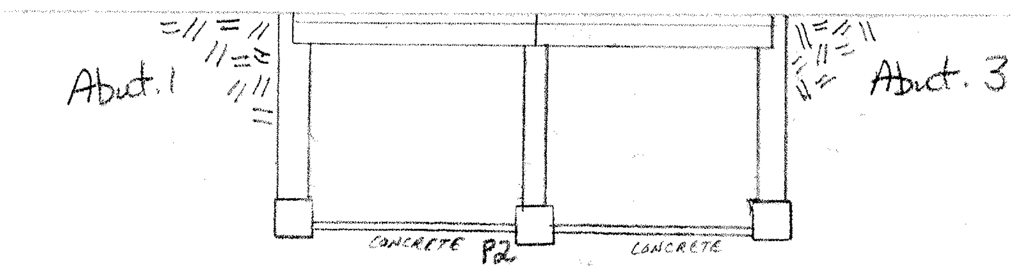


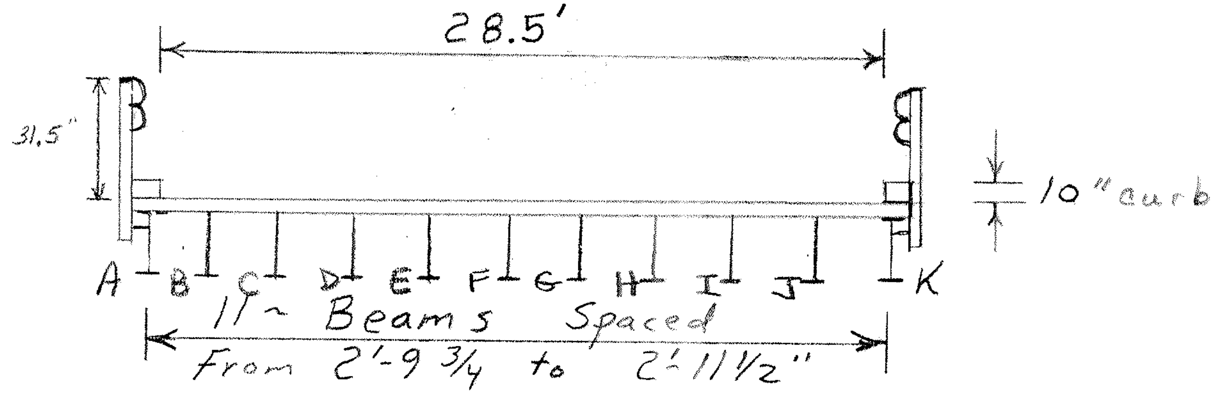
POINT	PIER 2	PIER 3	PIER 4
Station	20+15.75	20+73.75	21+31.75
Profile El. "L"	64.92	65.65	66.44
Top Cap El. "M"	60.27	61.00	61.79
Bot. Ftng. El. "N"	59.27	40.00	40.79
"Y" Dist.	4'-6½"	4'-6½"	4'-6⁹⁄₁₆"

COLORADO
DEPARTMENT OF HIG...
4 SPANS 48-58-58-48 CONC... AND CONTINUOUS WF BEAM... 1'-6" SAFETY CURB
DETAILS OF PIERS 2,3...
Across DOLORES RIVE...
Sta. 19+66 to 21+8...
Near GATEWAY Sec. 15 & 22 T...
THE BRODERICK ENGINEERING CO
9555 MONTVIEW BLVD
AURORA COLORADO Em 6-5442
Approved...
Date:

STR. NO. J-1-C


John Brown Creek Flow
N
41°
18'-0"
Span 1
18'-0"
Span 2


Abut. 1
Abut. 3
CONCRETE
P2
CONCRETE


28.5'
31.5"
10" curb
A
B
C
D
E
F
G
H
I
J
K
11 ~ Beams Spaced
From 2'-9 3/4 to 2'-11 1/2"

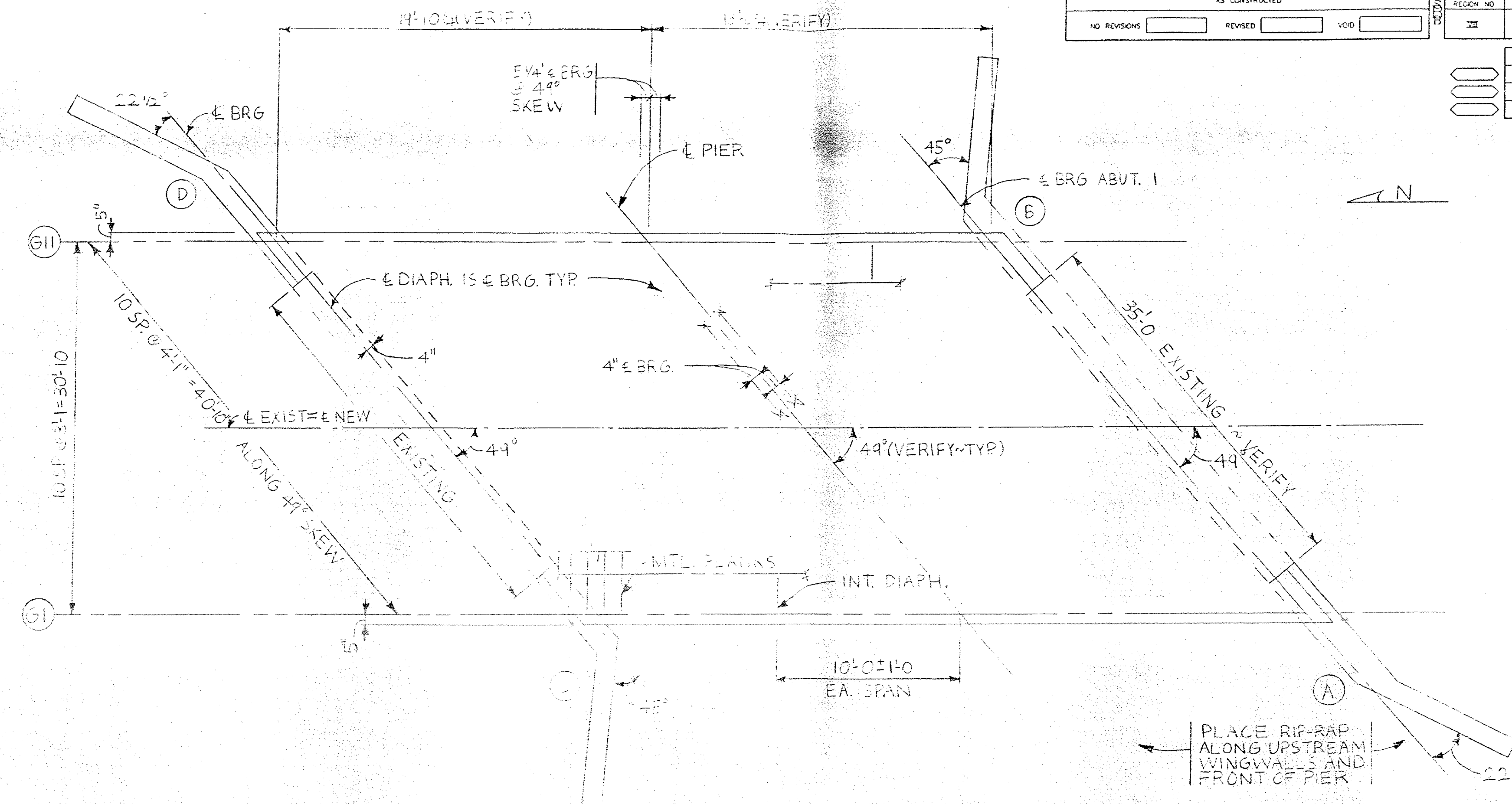
Timber Stringer wood deck = SSM

FEDERAL ROAD REGION NO.	DIVISION	PROJECT NUMBER	SHEET NUMBER
VIII	COLORADO	MP	1

AS CONSTRUCTED

NO REVISIONS | REVISED | VOID

REVISIONS



NOTES:

1. SOIL BEARING PRESSURE USED IN DESIGN= 3000 PSF. EFP= 40 PCF.
2. ANCHOR BOLTS SHALL BE ASTM A307 BOLTS OR ASTM A36 ALLTHREAD BARS.
3. SALVAGED STEEL BEAMS AND METAL DECK PLANKING SHALL BE IN GOOD CONDITION AND FREE OF ANY DEFECTS. STEEL BEAMS SHALL HAVE NO PREVIOUS WELDS ON THE BOTTOM FLANGES.
4. EPOXY FOR GROUTING IN DOWELS AND ANCHOR BOLTS SHALL BE HILTI HBP OR EQUIV. IN 1/4 INCH OVERSIZE HOLES.
5. DIMENSIONS AND SKEW ANGLES SHALL BE VERIFIED PRIOR TO FABRICATION.
6. CONCRETE SHALL BE CLASS B. f'_c=3000 PSI.
7. REMOVAL OF EXIST. CONC. SHALL BE WITH AN 1 1/2 INCH SAWCUT AND 10LB JACKHAMMER MAX. ALONG THE EDGE OF CONCRETE TO REMAIN.
8. ALL CONSTRUCTION SHALL ADHERE TO CDOH STANDARDS, SPECIFICATIONS, AND POLICIES.
9. LIVE LOAD - SERVICE LOAD DESIGN, AASHTO HS 20-44 AND INTERSTATE ALTERNATE.
10. REINFORCING STEEL - f_s=24,000 PSI, f_y=60,000 PSI.
11. STRUCTURAL STEEL - AASHTO M-183 (ASTM A36), f_s=20,000 PSI.
12. FIELD VERIFY ALL DIMENSIONS
13. LOCATE ALL POTENTIAL UNDERGROUND UTILITIES PRIOR TO CONSTRUCTION.
14. STRUCTURE EXCAVATION AND BACKFILL SHALL BE IN ACCORDANCE WITH STANDARD M-206-2.

BAR SIZE	#4	#5	#6	#7	#8	#9	#10	#11
SPLICE LENGTH FOR CLASS B CONCRETE	1'-3"	1'-6"	2'-0"	2'-8"	3'-6"	4'-5"	5'-7"	6'-10"

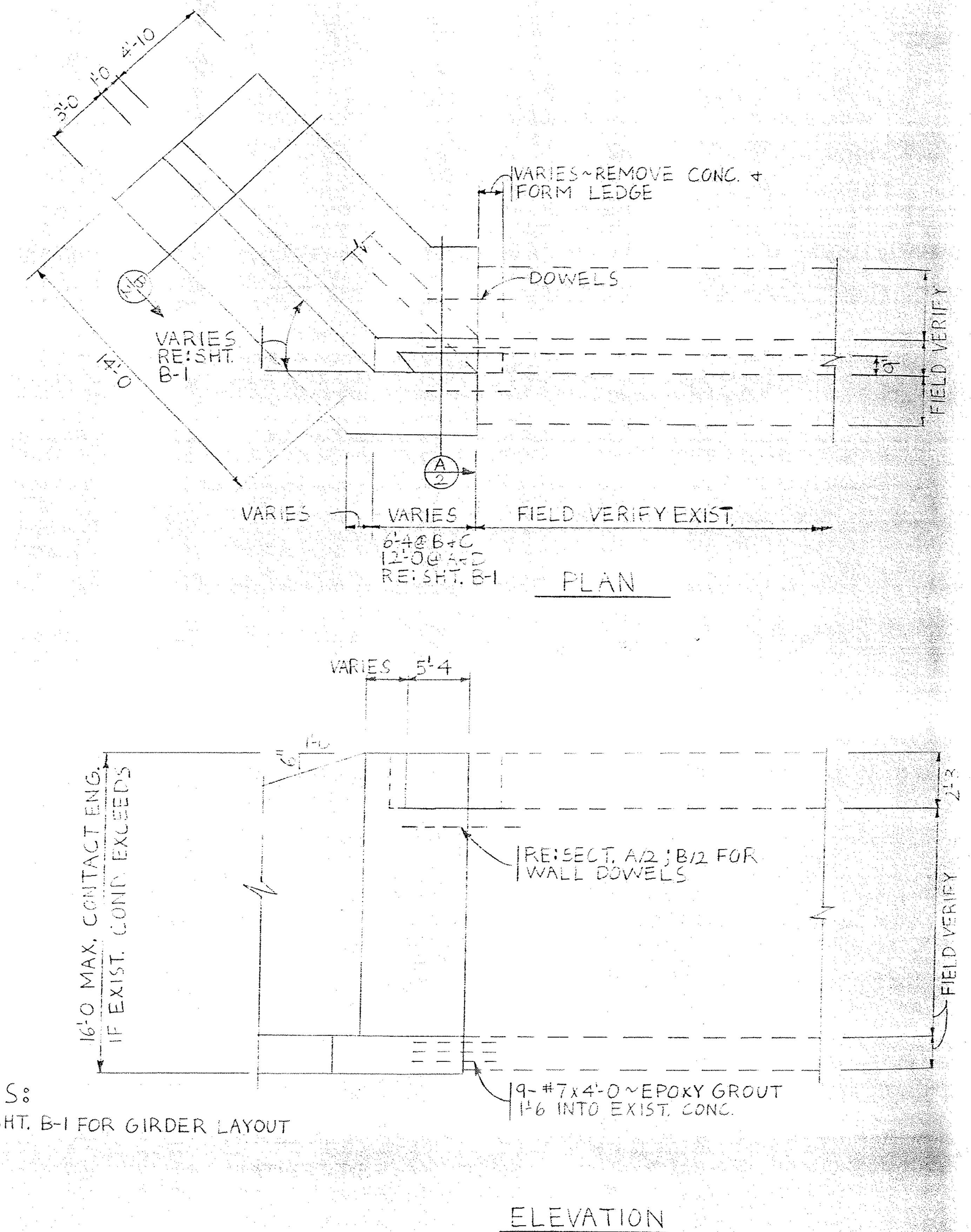
15. ALL REBAR HOOKS SHALL BE 1'-0 MIN.

DIVISION OF HIGHWAYS

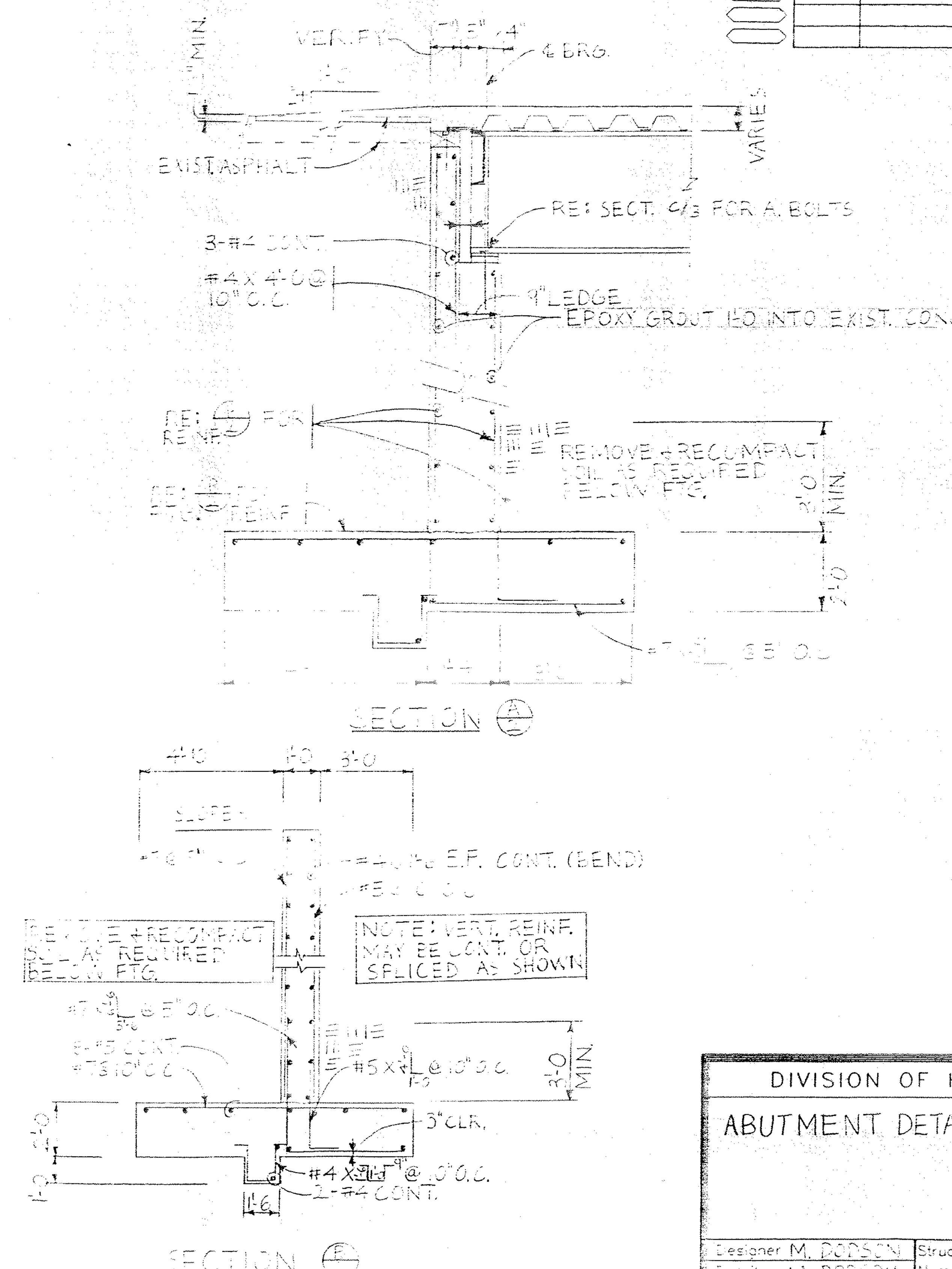
CONSTRUCTION LAYOUT

Designer M. DODSON	Structure Numbers	J-1-D
Detailer M. DODSON		
Drawing Number B1	of	Drawings

Designed By	Checked By	Detailed By	INITIAL	DATE	Checked By	Quantities By	Checked By



NOTES:
1. RE: SHT. B-1 FOR GIRDER LAYOUT



AS CONSTRUCTED		
NO REVISIONS	REVISED	VOID

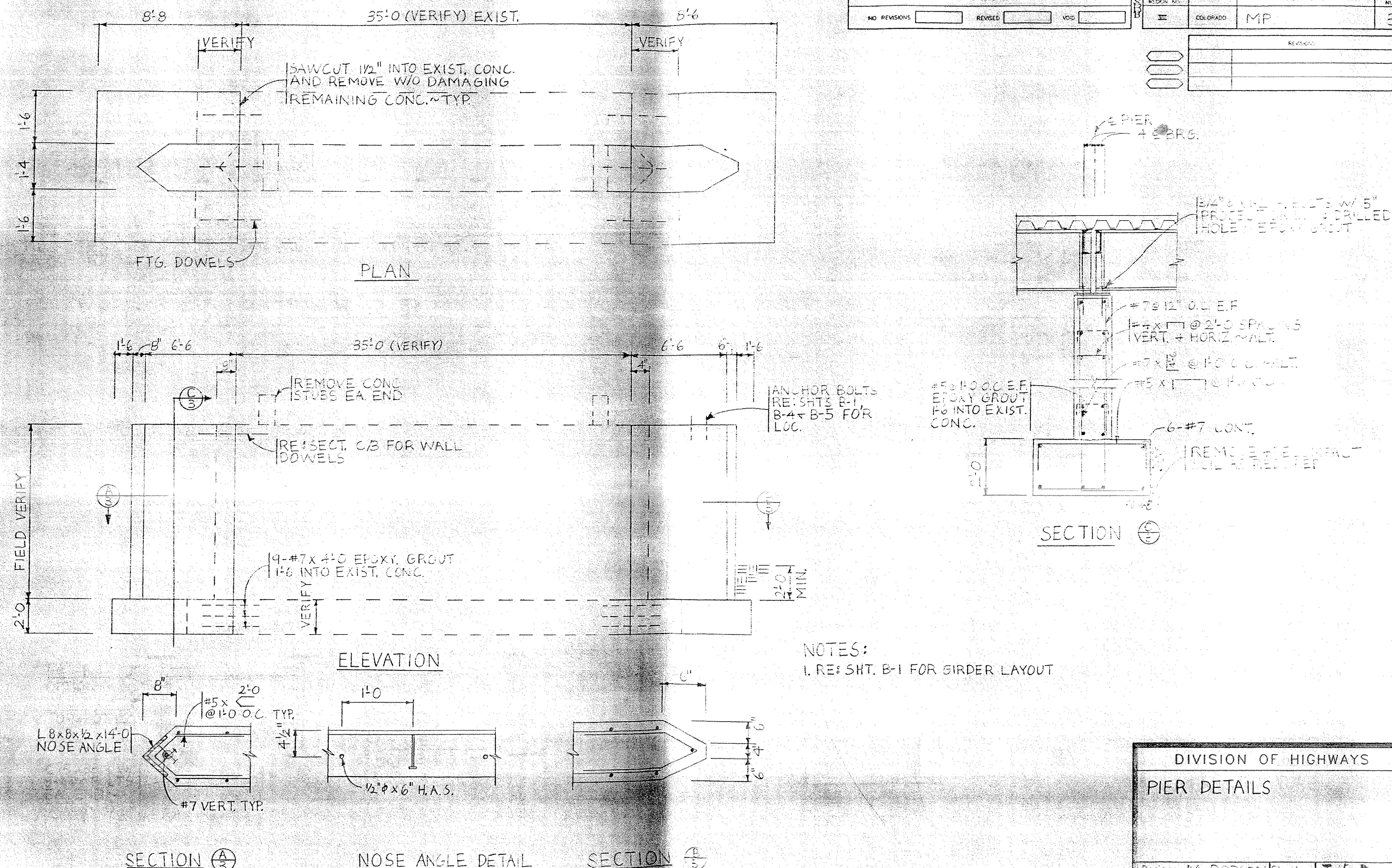
FEDERAL ROAD REGION NO.	DIVISION	PROJECT NUMBER	SHEET NUMBER
2	COLORADO	MP	

REVISIONS

DIVISION OF HIGHWAYS

ABUTMENT DETAILS

Designer M. DODSON		Structure Numbers	J-1-D
Detailer N. DODSON			
Drawing Number B2	of 6	Drawings	



NOTES:

1. RE: SHT. B-1 FOR GIRDER LAYOUT

AS CONSTRUCTED		
NO REVISIONS	REVISED	VOID

FEDERAL ROAD REGION NO.	DIVISION	PROJECT NUMBER	SHEET NUMBER
II	COLORADO	MP	3

REVISIONS

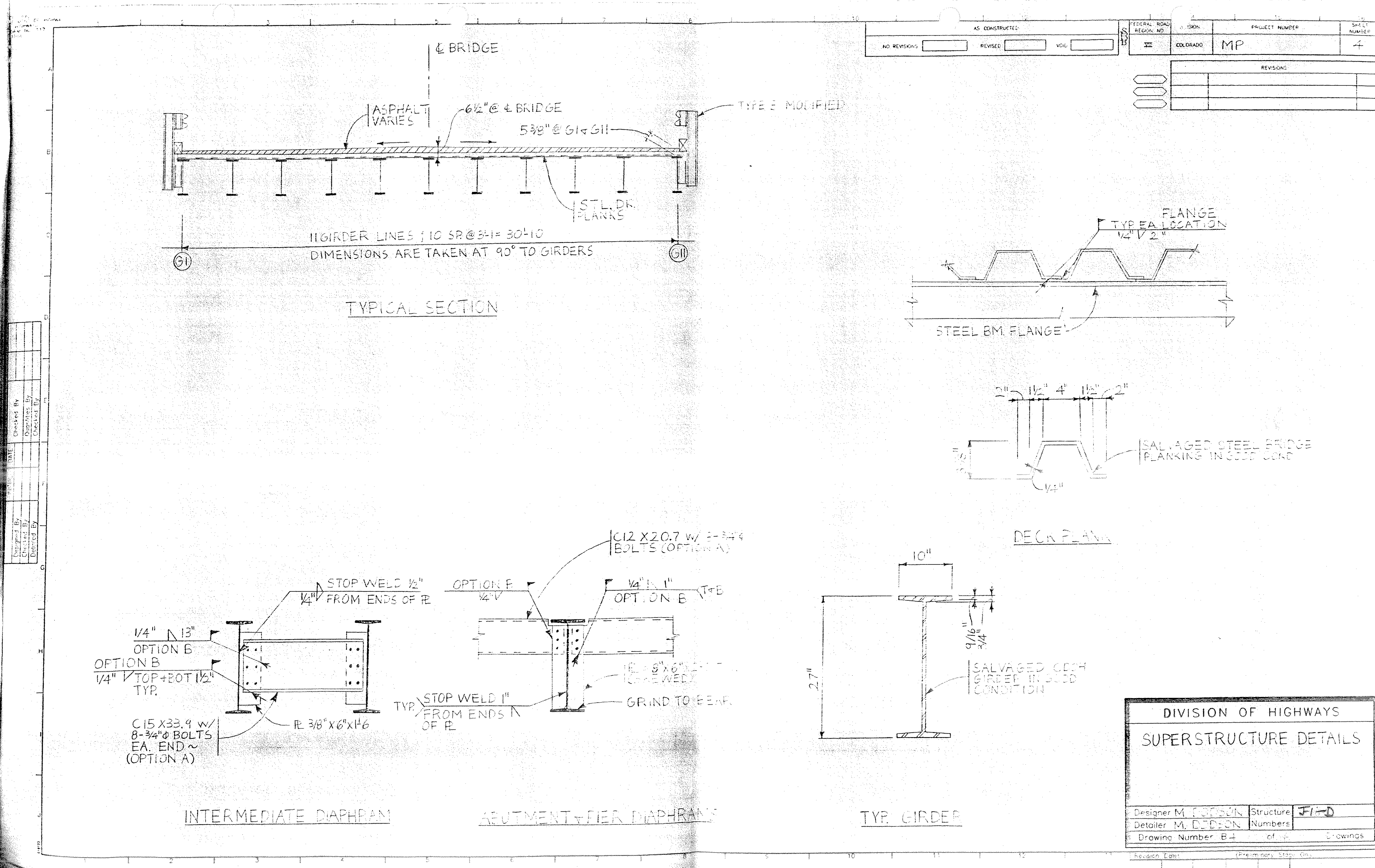
DIVISION OF HIGHWAYS

PIER DETAILS

Designer M. DODSON	Structure Numbers	J-10-D
Detailer M. DODSON		
Drawing Number B5	of 6	Drawings

Revision Dates (Preliminary Stage Only)

Designed By / Checked By / Detailed By / Quantities By / Checked By / Checked By



AS CONSTRUCTED
NO REVISIONS
REVISED
VOID
FEDERAL ROAD REGION NO.
COLORADO
PROJECT NUMBER
MP
SHEET NUMBER
4
REVISIONS
℄ BRIDGE
ASPHALT VARIES
6½"@ ℄ BRIDGE
5⅜"@ G1 & G11
TYPE 3 MODIFIED
STL. DK. PLANKS
11 GIRDER LINES ; 10 SP.@ 3'-1 = 30'-10
DIMENSIONS ARE TAKEN AT 90° TO GIRDERS
G1
G11
TYPICAL SECTION
FLANGE
TYP. EA. LOCATION
¼" 2"
STEEL BM. FLANGE
2" 1½" 4" 1½" 2"
SALVAGED STEEL BRIDGE
PLANKING IN GOOD COND.
¼"
DECK PLANK
C12 X 20.7 W/
BOLTS (OPTION A)
STOP WELD ½"
FROM ENDS OF ℙ
¼"
OPTION B
¼"
¼" 1"
OPTION B
T&B
¼" 13"
OPTION B
OPTION B
¼" TOP+BOT 1½"
TYP.
C15 X 33.9 W/
8-¾"φ BOLTS
EA. END ~
(OPTION A)
℗ ⅜" X 6" X 1'-6
TYP.
STOP WELD 1"
FROM ENDS
OF ℙ
GRIND TO BEAR
10"
9/16"
¾"
27"
SALVAGED DECK
GIRDER IN GOOD
CONDITION
INTERMEDIATE DIAPHRAM
ABUTMENT & PIER DIAPHRAMS
TYP. GIRDER
DIVISION OF HIGHWAYS
SUPERSTRUCTURE DETAILS
Designer M. DODSON
Detailer M. DODSON
Drawing Number B4
Structure
Numbers
Drawings
Revision Date
Designed By
Checked By
Detailed By
Quantities By
Checked By
DATE

AS CONSTRUCTED		
NO REVISIONS	REVISED	VOID

FEDERAL ROAD REGION NO.	DIVISION	PROJECT NUMBER	SHEET NUMBER
VIII	COLORADO	MP	5

REVISIONS

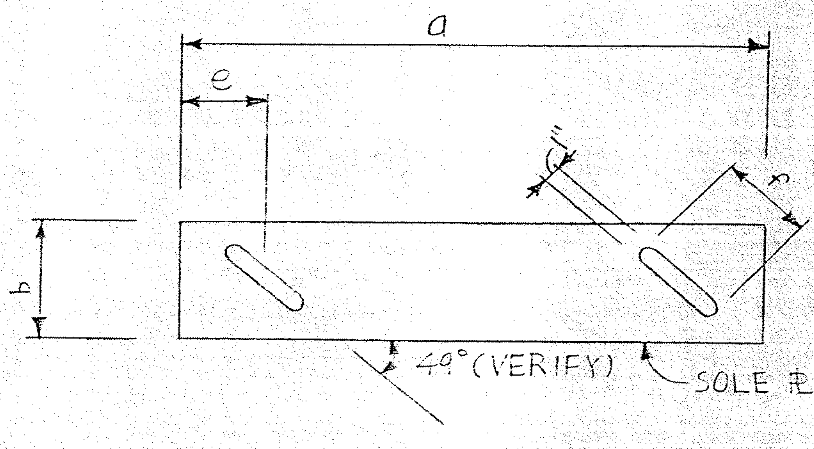
B-512-1

NOTES:

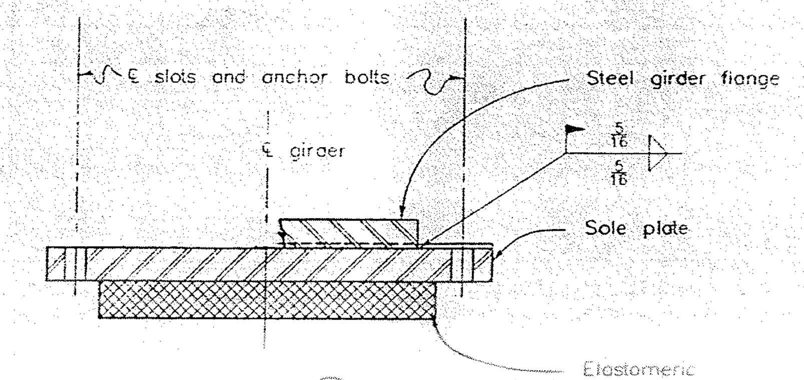
Anchor bolt nuts shall be snugged and jammed with jam nuts at fixed bearings. At expansion bearings, provide $\frac{1}{8}$" clearance between jam nut and sole plate under all temperature conditions prior to jamming.

Do not paint steel surfaces in contact with elastomeric pad.

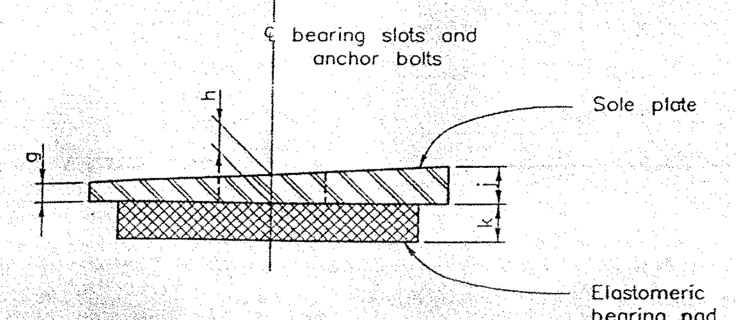
Elastomeric pad, Sole plate, anchor bolts and miscellaneous hardware shall be included in the bid price for Item 512, Bearing Device (Type I).



PLAN

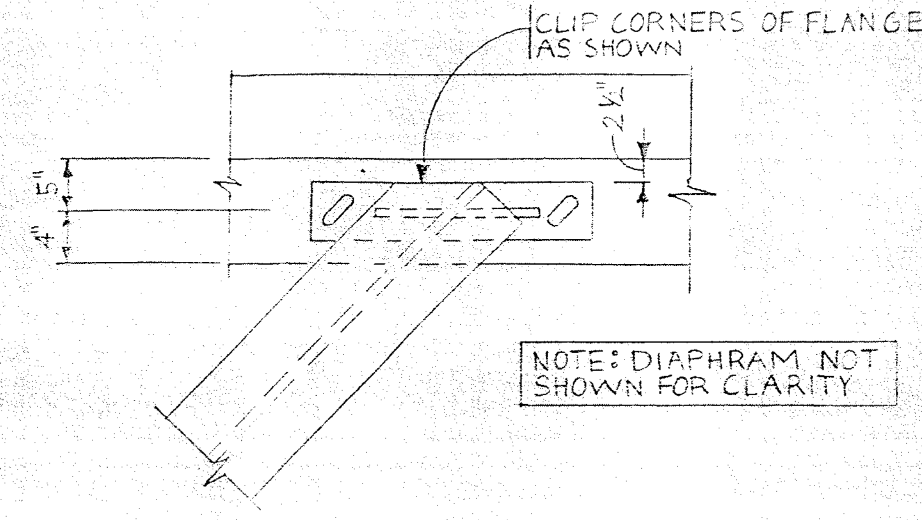


SECTION B/A

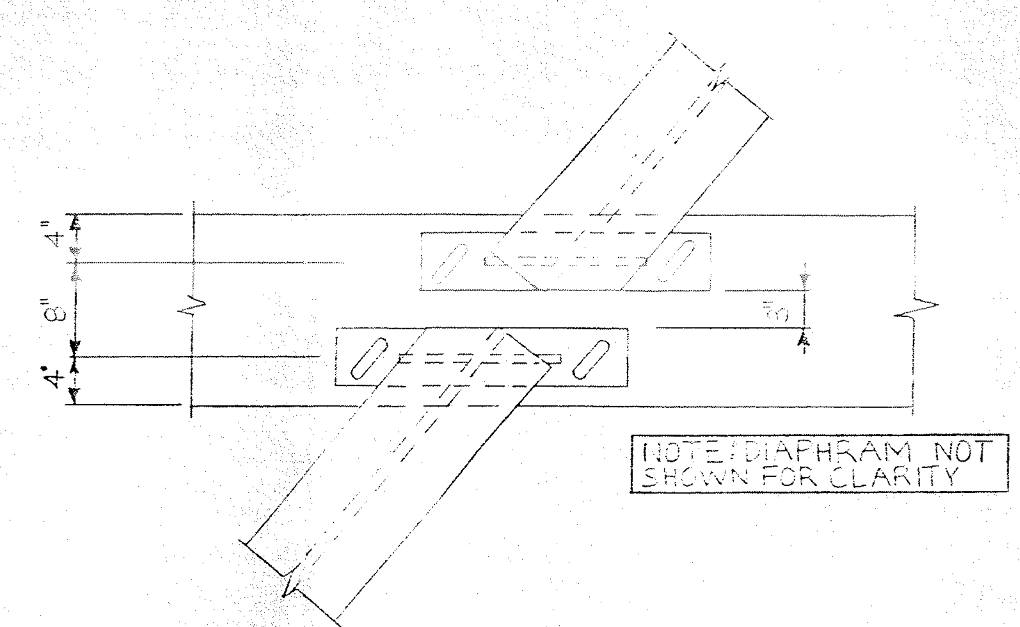


SECTION B/B

ELASTOMERIC BEARING DETAILS



PLAN AT ABUT.



PLAN AT PIER

Location	No. Req'd	Dimensions (Inches)									
		a	b	c	d	e	f	g	h	j	k
ABUT.'S	22	24	5			3½	4	½	½	½	3/4
PIER	22	24	5			3½	1	½	½	½	3/4

DIVISION OF HIGHWAYS

BEARING DEVICE
(TYPE I)

Designer M. DODSON	Structure Numbers	J-1-D ~~J-10-D~~
Detailer M. DODSON		
Drawing Number B5	of 6	Drawings

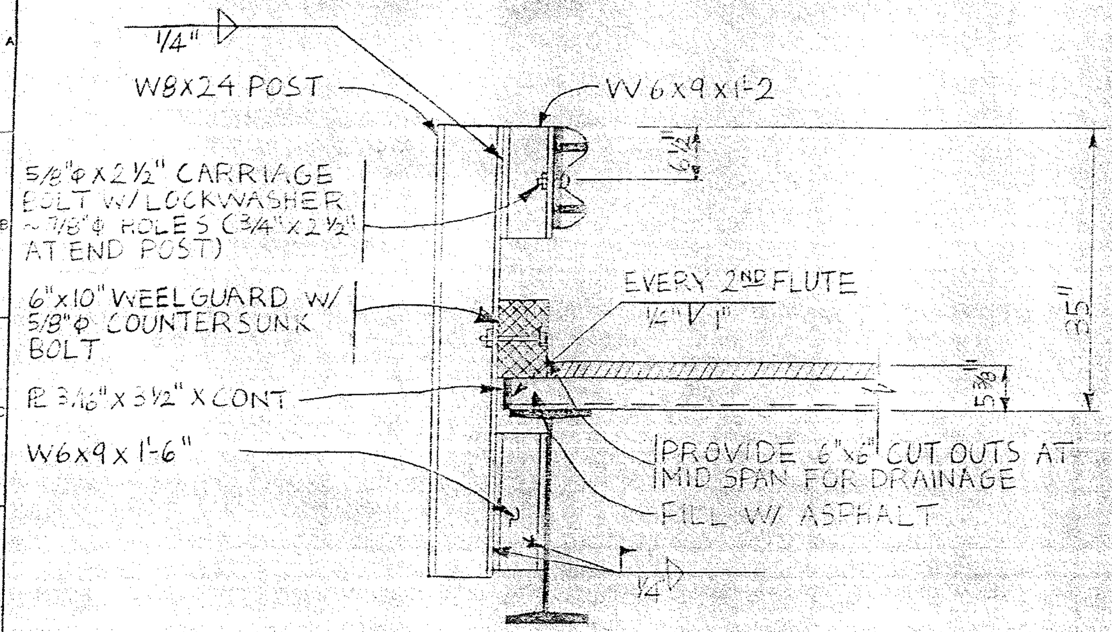
Revision Dates (Preliminary Stage Only)
12-87 10-88

Checked By
Detailed By
Quantities By
Checked By

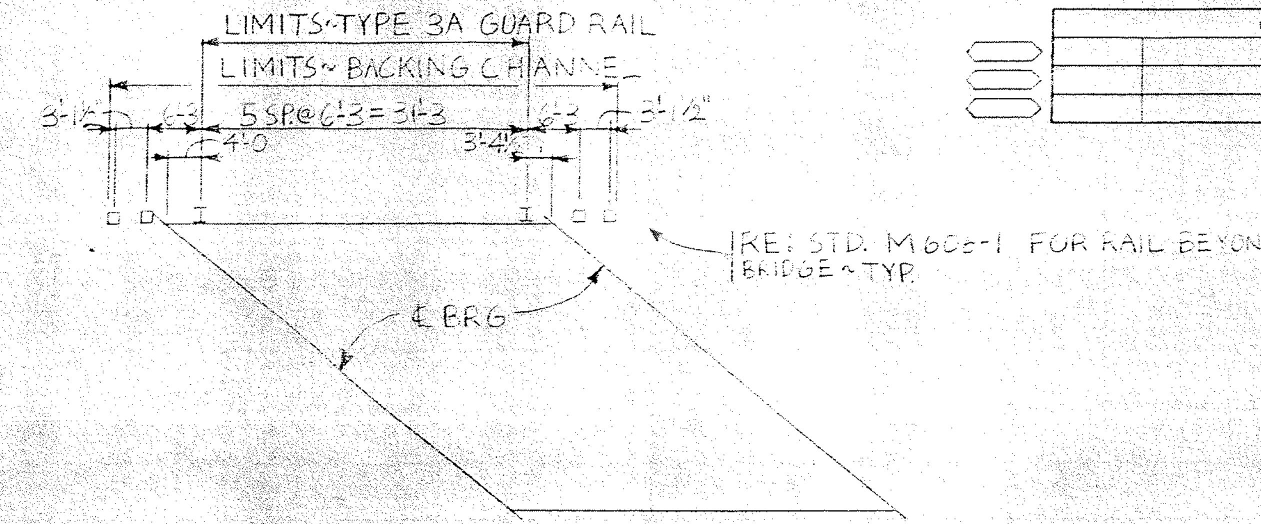
AS CONSTRUCTED		
NO REVISIONS	REVISED	VOID

FEDERAL ROAD REGION NO.	DIVISION	PROJECT NUMBER	SHEET NUMBER
II	COLORADO	MP	6

REVISIONS

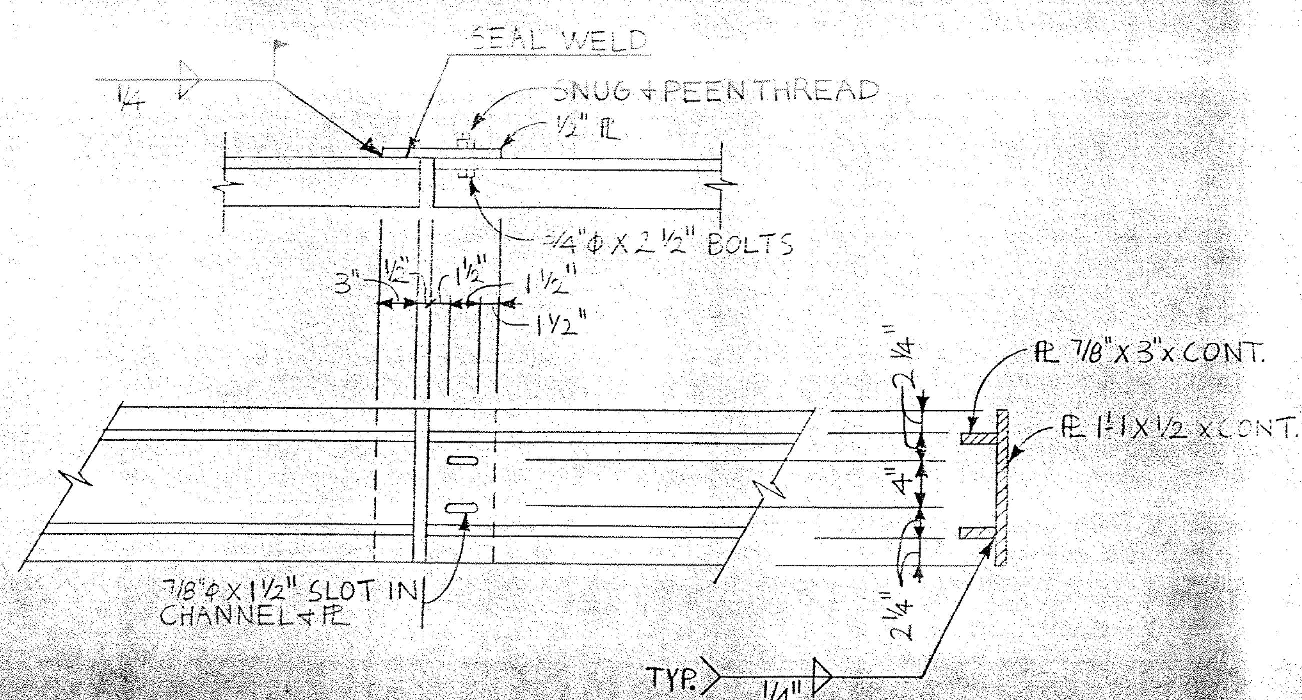


POST MOUNTING DETAILS



BRIDGE RAIL SPACING

TYP. BOTH SIDES



CHANNEL SPLICE DETAILS

NOTES:

1. ALL POSTS, POST BLOCKS, CHANNELS, CHANNEL SPLICES, ANGLE ASSEMBLIES, BOLTS, NUTS, AND WASHERS SHALL BE GALVANIZED AFTER FABRICATION IN ACCORDANCE WITH THE SPECIFICATIONS.
2. CHANNELS SHALL BE CONTINUOUS OVER NOT LESS THAN TWO POST.
3. POSTS SHALL BE PERPENDICULAR TO THE GRADE OF THE DECK.
4. CONTRACTOR SHALL PROVIDE TERMINAL SECTION (FLARED) WHEN NO APPROACH GUARD RAIL IS USED WITH THE COST INCLUDED IN ITEM NO. 606-BRIDGE RAIL, TYPE 3 MODIFIED. FOR DETAILS SEE STD M-606-1.
5. FOR ADDITIONAL DETAILS SEE STD M-606-1.
6. ALL WORK SHALL BE DONE ACCORDING TO THE STANDARD SPECIFICATIONS OF THE DIVISION OF HIGHWAYS, STATE OF COLORADO, APPLICABLE TO THE PROJECT.
7. ALL STRUCTURAL STEEL SHALL BE AASHTO SPECIFICATION M-183. (ASTM A-36).

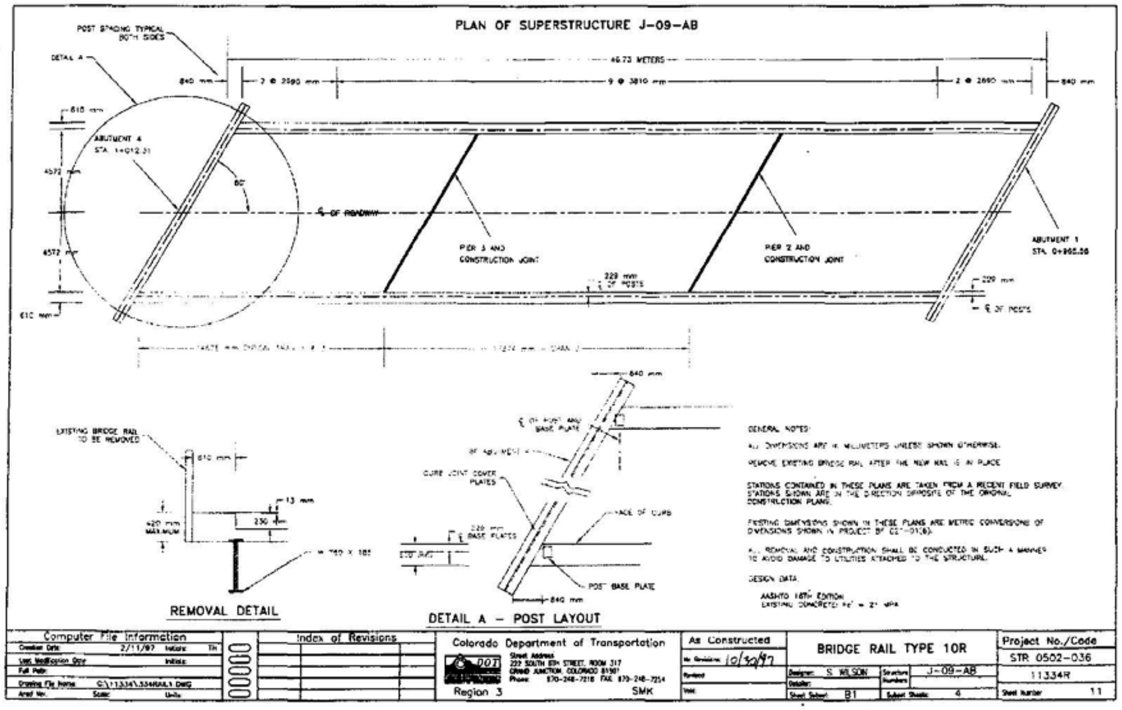
Designed By	Checked By	Detailed By	INITIAL	DATE	Checked By	Quantities By	Checked By

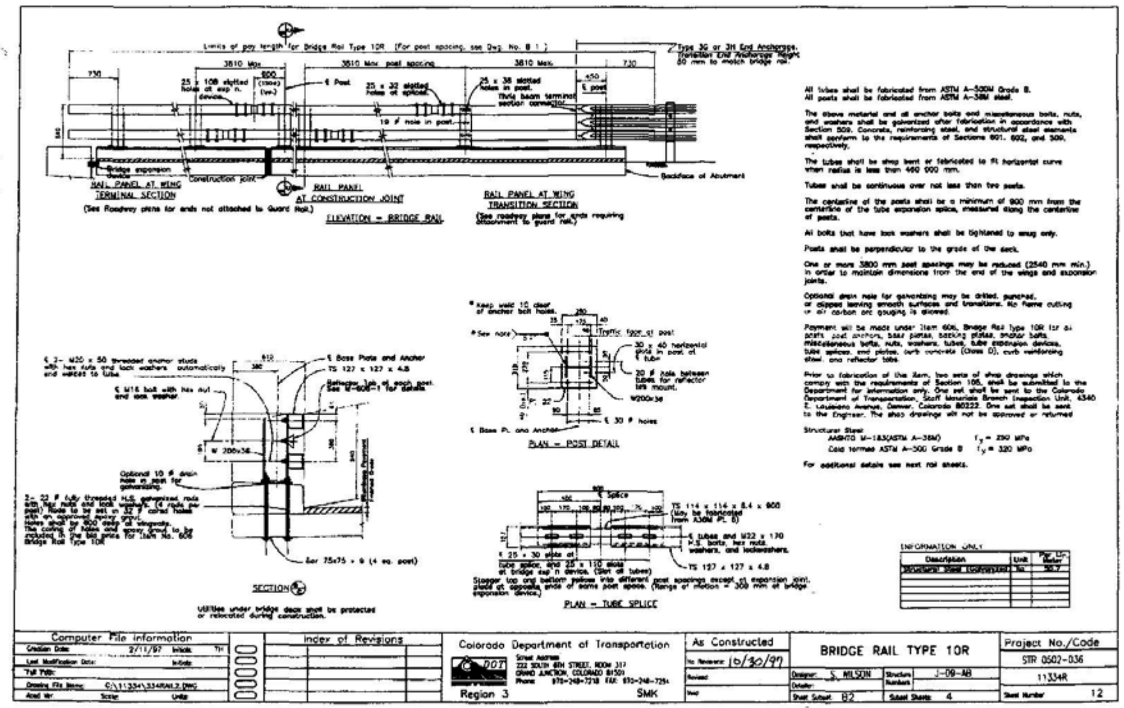
DIVISION OF HIGHWAYS

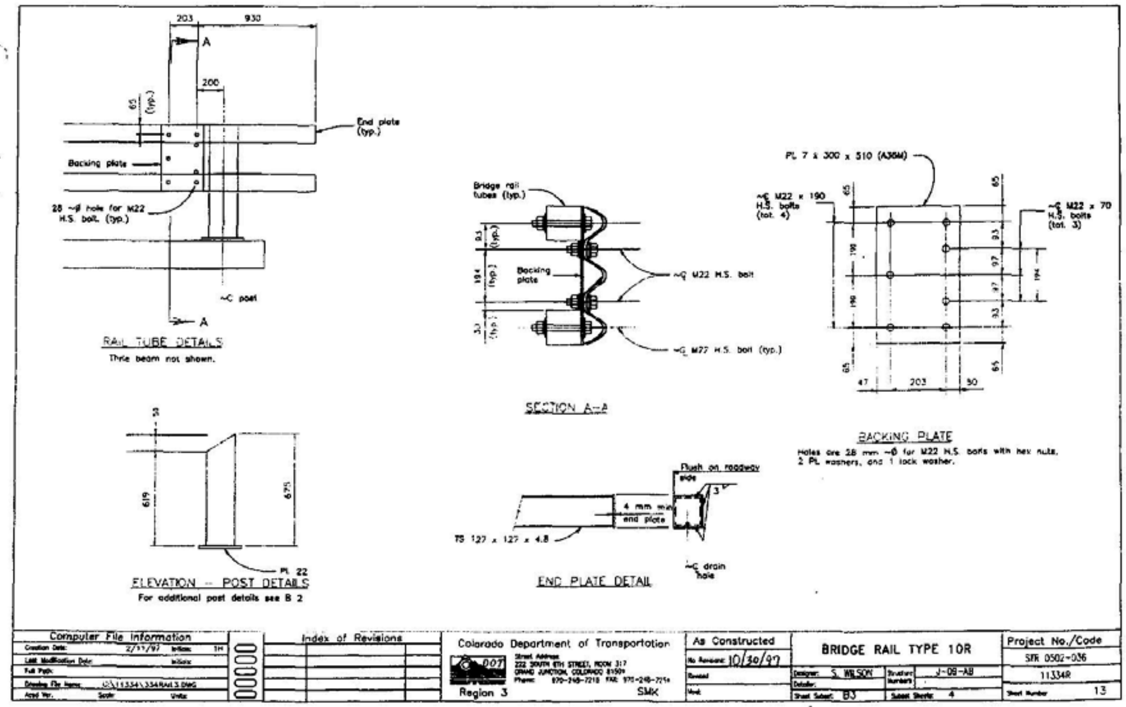
BRIDGE RAIL TYPE 3 (MODIFIED)

Designer M. DODSON	Structure Numbers	~~I-10-D~~ J-1-D
Detailer M. DODSON		
Drawing Number B6	of 6	Drawings

Revision Date: (Preliminary Stage Only)


PLAN OF SUPERSTRUCTURE J-09-AB
46.73 METERS
REMOVAL DETAIL
DETAIL A – POST LAYOUT
Computer File Information
Index of Revisions
Colorado Department of Transportation
Region 3
SMK
As Constructed
BRIDGE RAIL TYPE 10R
S. WILSON
J-09-AB
Project No./Code
STR 0502-036
11334R


ELEVATION – BRIDGE RAIL
PLAN – POST DETAIL
PLAN – TUBE SPLICE
Computer File Information
Index of Revisions
Colorado Department of Transportation
Region 3
As Constructed
10/30/97
BRIDGE RAIL TYPE 10R
Project No./Code
STR 0502-036
11334R
J-09-AB


RAIL TUBE DETAILS
Thrie beam not shown.
End plate (typ.)
Backing plate
SECTION A-A
BACKING PLATE
Holes are 28 mm ~Ø for M22 H.S. bolts with hex nuts, 2 PL washers, and 1 lock washer.
ELEVATION -- POST DETAILS
For additional post details see B 2
END PLATE DETAIL
Flush on roadway side
TS 127 x 127 x 4.8
Computer File Information
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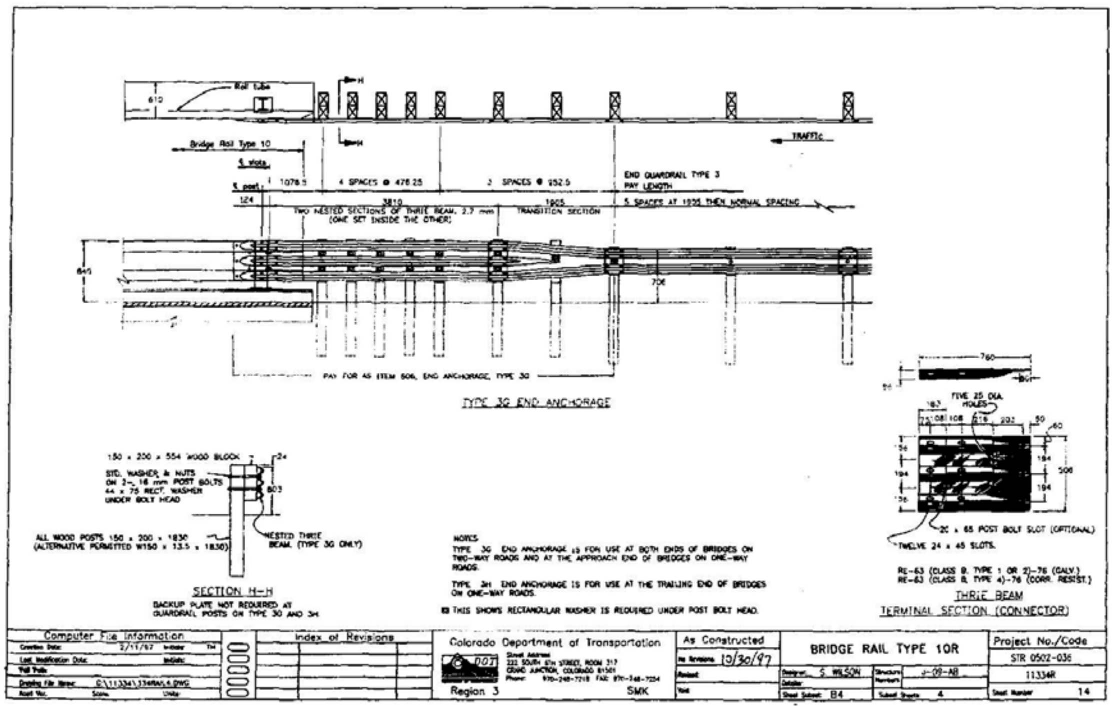
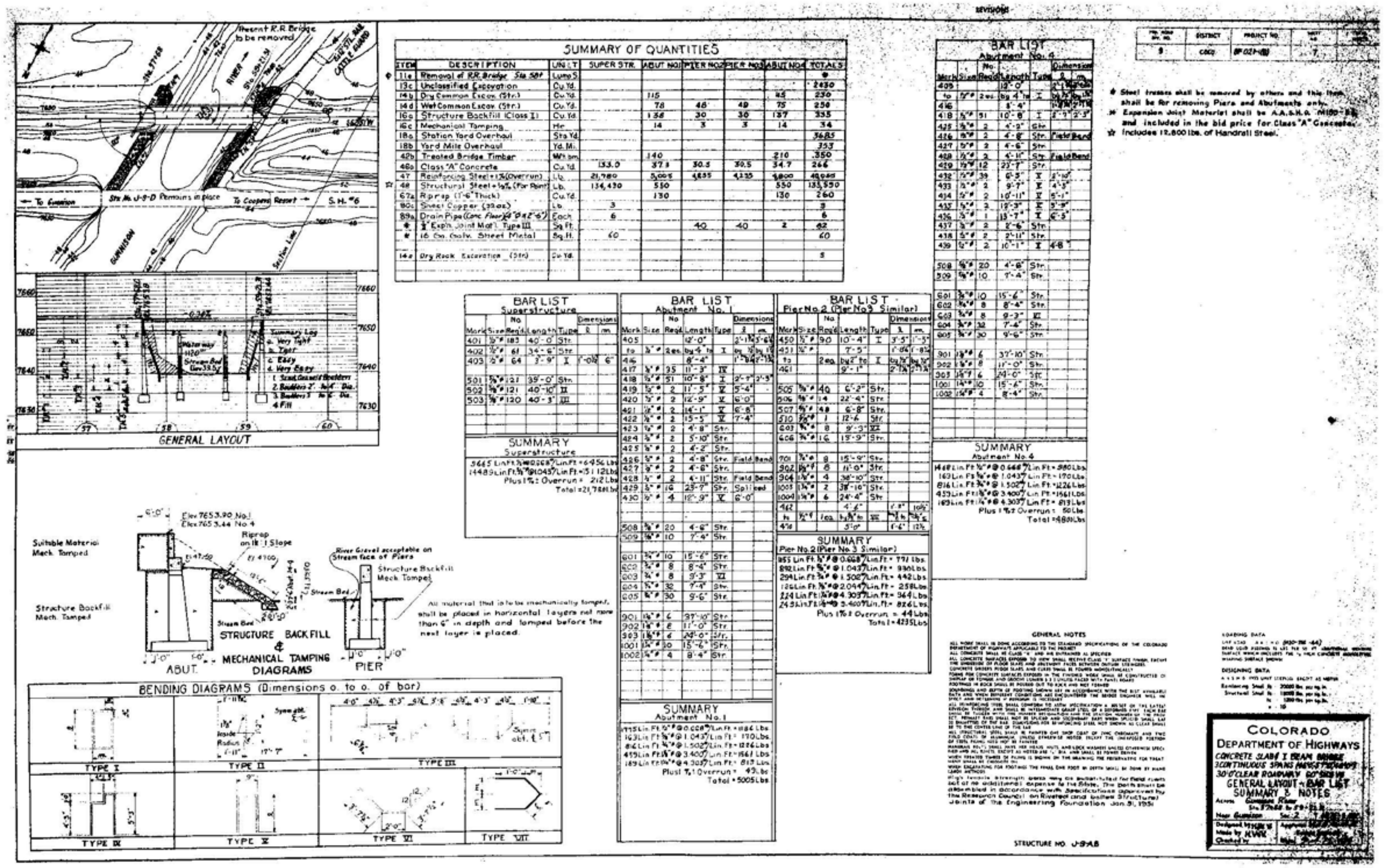
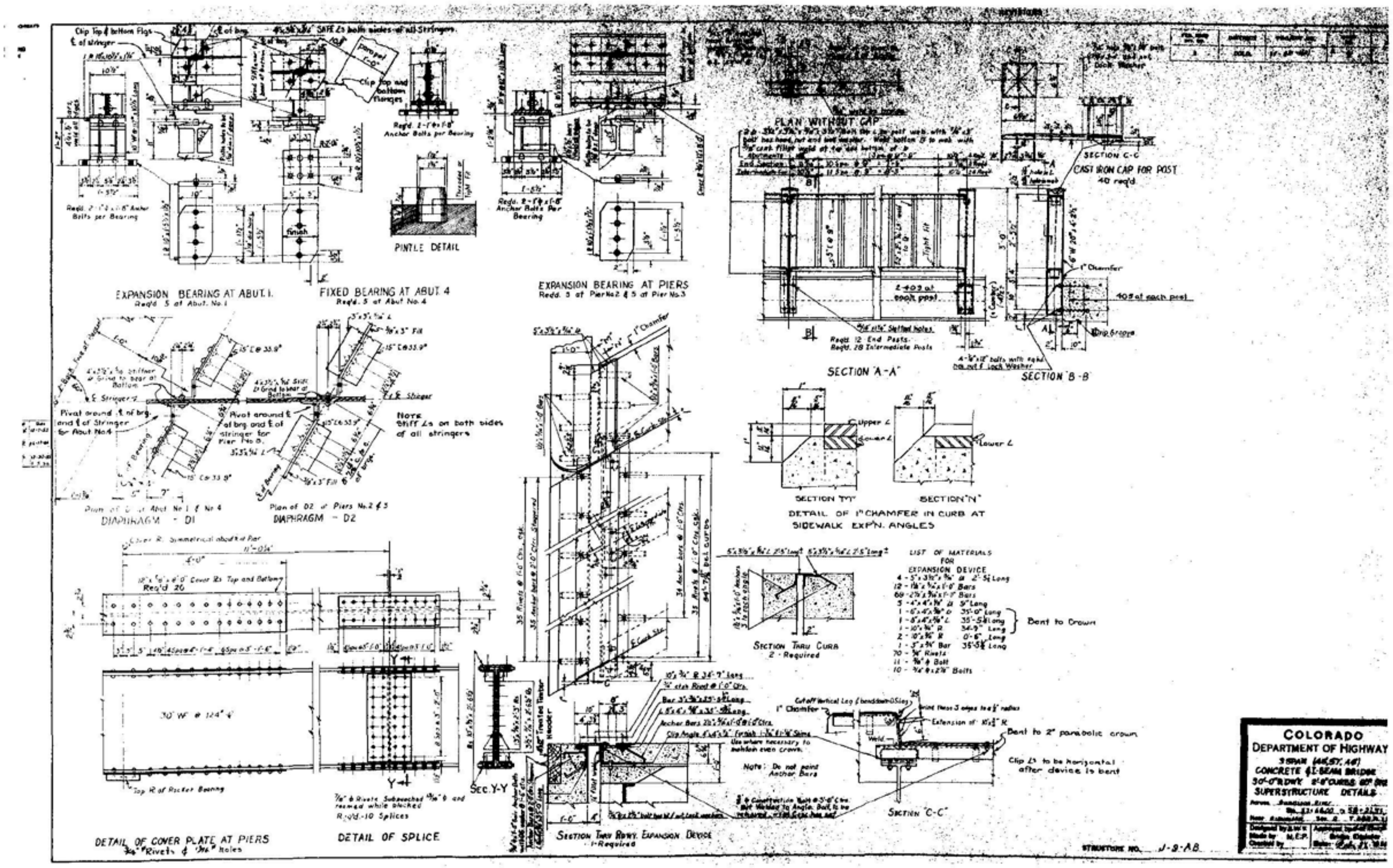
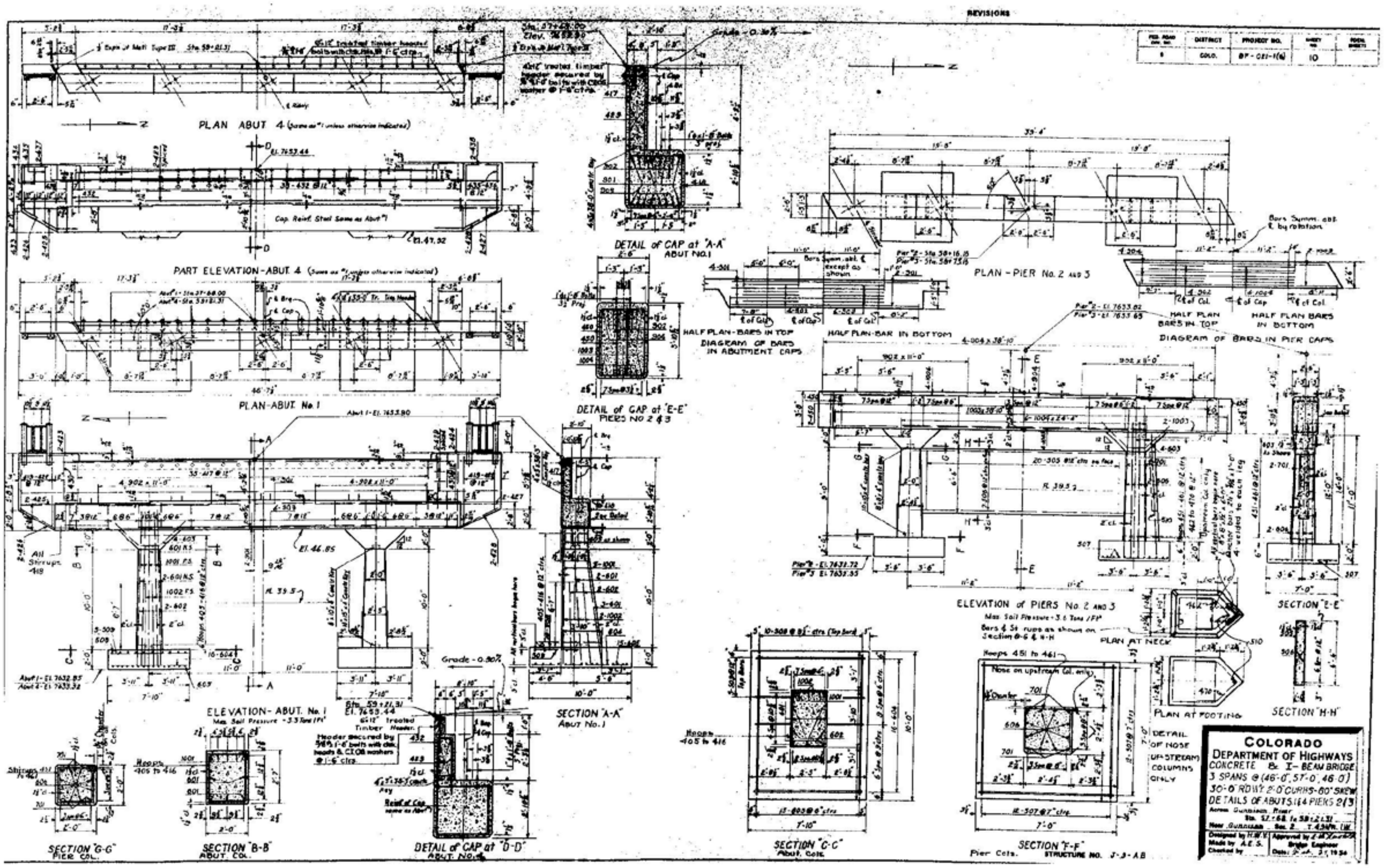
Colorado Department of Transportation
Region 3
As Constructed
10/30/97
BRIDGE RAIL TYPE 10R
S. WILSON
J-09-AB
Project No./Code
STR 0502-036
11334R
13

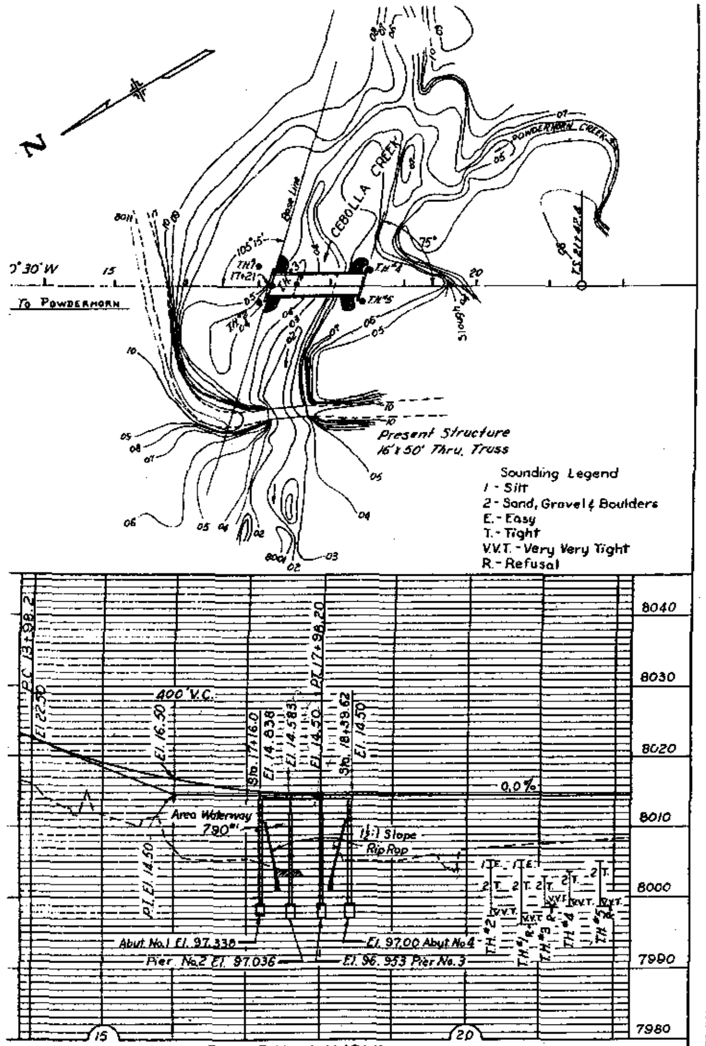

TYPE 3G END ANCHORAGE
SECTION H-H
BACKUP PLATE NOT REQUIRED AT GUARDRAIL POSTS ON TYPE 3G AND 3H
ALL WOOD POSTS 150 x 200 x 1830 (ALTERNATIVE PERMITTED W150 x 13.5 x 1830)
NESTED THRIE BEAM. (TYPE 3G ONLY)
NOTES
TYPE 3G END ANCHORAGE IS FOR USE AT BOTH ENDS OF BRIDGES ON TWO-WAY ROADS AND AT THE APPROACH END OF BRIDGES ON ONE-WAY ROADS.
TYPE 3H END ANCHORAGE IS FOR USE AT THE TRAILING END OF BRIDGES ON ONE-WAY ROADS.
THIS SHOWS RECTANGULAR WASHER IS REQUIRED UNDER POST BOLT HEAD.
TWELVE 24 x 45 SLOTS.
RE-63 (CLASS B, TYPE 1 OR 2)-76 (GALV.)
RE-63 (CLASS B, TYPE 4)-76 (CORR. RESIST.)
THRIE BEAM TERMINAL SECTION (CONNECTOR)
Computer File Information
Index of Revisions
Colorado Department of Transportation
Region 3
SMK
As Constructed
10/30/97
BRIDGE RAIL TYPE 10R
S. WILSON
J-09-AB
Project No./Code
STR 0502-036
11334R
14


SUMMARY OF QUANTITIES
BAR LIST Superstructure
BAR LIST Abutment No. 1
BAR LIST Pier No. 2 (Pier No. 3 Similar)
BAR LIST Abutment No. 4
SUMMARY
GENERAL LAYOUT
STRUCTURE BACKFILL & MECHANICAL TAMPING DIAGRAMS
ABUT.
PIER
BENDING DIAGRAMS (Dimensions o. to o. of bar)
GENERAL NOTES
STRUCTURE NO. J-9-AB
COLORADO
DEPARTMENT OF HIGHWAYS
GENERAL LAYOUT - BAR LIST
SUMMARY & NOTES


EXPANSION BEARING AT ABUT. I.
FIXED BEARING AT ABUT. 4
PINTLE DETAIL
EXPANSION BEARING AT PIERS
PLAN WITHOUT CAP
SECTION 'A-A'
SECTION 'B-B'
SECTION C-C
CAST IRON CAP FOR POST
DIAPHRAGM - D1
DIAPHRAGM - D2
DETAIL OF 1" CHAMFER IN CURB AT SIDEWALK EXP'N. ANGLES
SECTION THRU CURB
LIST OF MATERIALS FOR EXPANSION DEVICE
DETAIL OF COVER PLATE AT PIERS
DETAIL OF SPLICE
SEC. Y-Y
SECTION THRU RDWY. EXPANSION DEVICE
COLORADO
DEPARTMENT OF HIGHWAYS
SUPERSTRUCTURE DETAILS
STRUCTURE NO. J-9-AB


PLAN ABUT 4
PART ELEVATION-ABUT 4
PLAN-ABUT No.1
ELEVATION- ABUT. No. I
SECTION "G-G" PIER COL.
SECTION "B-B" ABUT. COL.
DETAIL of CAP at "D-D" ABUT. No.4
SECTION "A-A" ABUT No. 1
DETAIL of CAP at "A-A" ABUT NO.1
DETAIL of CAP at "E-E" PIERS NO 2 & 3
HALF PLAN-BARS IN TOP
HALF PLAN-BAR IN BOTTOM
DIAGRAM OF BARS IN ABUTMENT CAPS
PLAN - PIER No. 2 AND 3
HALF PLAN BARS IN TOP
HALF PLAN BARS IN BOTTOM
DIAGRAM OF BARS IN PIER CAPS
ELEVATION of PIERS No. 2 AND 3
SECTION "E-E"
PLAN AT NECK
PLAN AT FOOTING
SECTION "H-H"
SECTION "C-C" Abut. Cols.
SECTION "F-F" Pier Cols.
STRUCTURE NO. J-9-AB
COLORADO
DEPARTMENT OF HIGHWAYS
CONCRETE & I-BEAM BRIDGE
3 SPANS @ (46'-0", 57'-0", 46'-0")
30'-0" RDWY 2'-0" CURBS-60° SKEW
DETAILS OF ABUTS 1 & 4 PIERS 2 & 3
REVISIONS

FED. RD. DIV. NO.	DISTRICT	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	S 0117(3)	7	



GENERAL LAYOUT

BAR LIST SUPERSTRUCTURE

Mark	Size	No. Req'd	Length	Type	Dimensions ℓ	Dimensions m
401	½"φ	156	40'-0"	Str.		
402	½"φ	80	4'-2"	I	1'-1"	8"
403	½"φ	72	6'-3"	I	2'-3½"	6"
501	⅝"φ	112	27'-3"	II		
502	⅝"φ	111	28'-9"	III		
503	⅝"φ	111	26'-7"	Str.		
504	⅝"φ	417	7'-3"	IV		
505	⅝"φ	80	2'-11"	V		
701	⅞"φ	16	21'-9"	Str.		
1101	1⅜"φ	24	41'-1"	Str.		
1102	1⅜"φ	12	40'-5"	Str.		
1103	1⅜"φ	18	31'-6"	Str.		
1104	1⅜"φ	18	25'-0"	Str.		
1105	1⅜"φ	18	18'-4"	Str.		
1106	1⅜"φ	18	11'-0"	Str.		

SUMMARY

7023 Lin.Ft. ½"φ @ 0.668 lbs/lin.ft. = 4891 Lbs.
12451 Lin.Ft. ⅝"φ @ 1.043 lbs/lin.ft. = 12,986 Lbs.
348 Lin.Ft. ⅞"φ @ 2.044 lbs/lin.ft. = 711 Lbs.
3016 Lin.Ft. 1⅜"φ @ 5.313 lbs/lin.ft. = 16,024 Lbs.
Plus 1% ± for overrun = 343 Lbs.
Total = 34,755 Lbs.

BAR LIST - PIER No. 2 (PIER No. 3 SIMILAR)

Mark	Size	No. Req'd	Length	Type	Dimensions ℓ	Dimensions m
408	½"φ	12	7'-8"	I	1'-9"	1'-9"
409	½"φ	12	16'-9"	Str.		
410	½"φ	20	11'-0"	Str.		
411	½"φ	26	8'-4"	I	2'-1"	1'-9"
412	½"φ	12	8'-3"	IX		
509	⅝"φ	20	4'-6"	Str.		
510	⅝"φ	2	25'-4"	Str.		
602	¾"φ	16	13'-0"	Str.		
803	1"φ	2	16'-9"	Str.		
804	1"φ	12	3'-0"	VI		
901	1⅛"φ	2	25'-4"	Str.		
902	1⅛"φ	4	8'-8"	Str.		

SUMMARY

830 Lin.Ft. ½"φ @ 0.668 lbs/lin.ft. = 554 Lbs.
141 Lin.Ft. ⅝"φ @ 1.043 lbs/lin.ft. = 147 Lbs.
208 Lin.Ft. ¾"φ @ 1.502 lbs/lin.ft. = 312 Lbs.
70 Lin.Ft. 1"φ @ 2.670 lbs/lin.ft. = 187 Lbs.
85 Lin.Ft. 1⅛"φ @ 3.400 lbs/lin.ft. = 289 Lbs.
Plus 1% ± for overrun = 16 Lbs.
Total = 1505 Lbs.

BAR LIST - ABUT. No. 1 (ABUT. No. 4 SIMILAR)

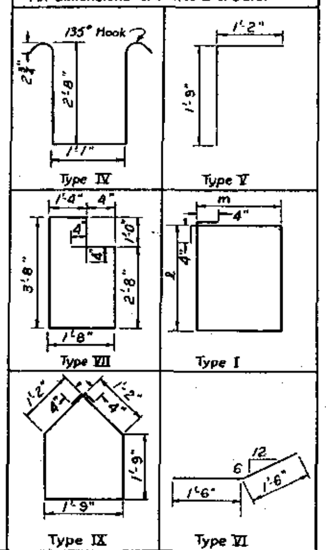
Mark	Size	No. Req'd	Length	Type	Dimensions ℓ	Dimensions m
404	½"φ	18	11'-4"	VII		
405	½"φ	8	4'-0"	Str.		
406	½"φ	6	4'-6"	Str.		
407	½"φ	4	3'-6"	Str.		
408	½"φ	26	7'-8"	I	1'-9"	1'-9"
503	⅝"φ	2	26'-7"	Str.		
506	⅝"φ	2	32'-10"	Str.		
507	⅝"φ	6	10'-0"	VIII		
508	⅝"φ	10	5'-6"	Str.		
509	⅝"φ	12	4'-6"	Str.		
601	¾"φ	24	13'-6"	Str.		
801	1"φ	4	32'-10"	Str.		
802	1"φ	4	26'-7"	Str.		

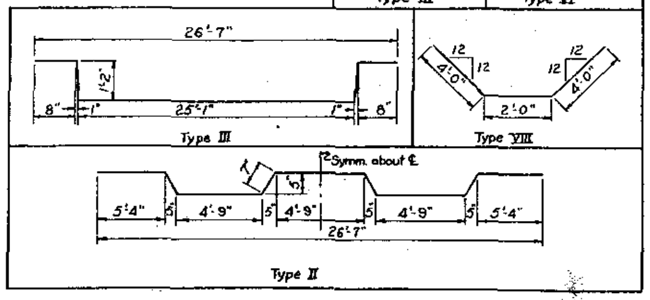
SUMMARY

476 Lin.Ft. ½"φ @ 0.668 lbs/lin.ft. = 318 Lbs.
288 Lin.Ft. ⅝"φ @ 1.043 lbs/lin.ft. = 300 Lbs.
324 Lin.Ft. ¾"φ @ 1.502 lbs/lin.ft. = 487 Lbs.
238 Lin.Ft. 1"φ @ 2.670 lbs/lin.ft. = 635 Lbs.
Plus 1% ± for overrun = 15 Lbs.
Total = 1755 Lbs.

BENDING DIAGRAMS

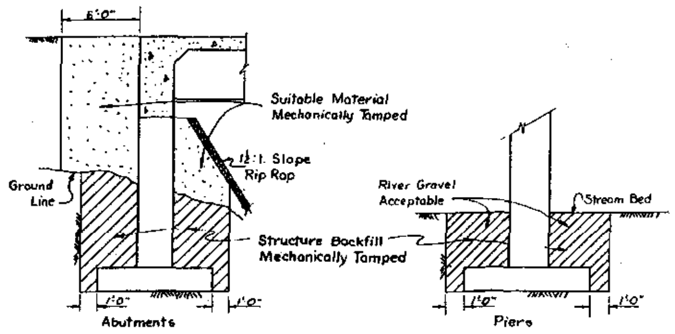
All dimensions are o. to o. of bars.





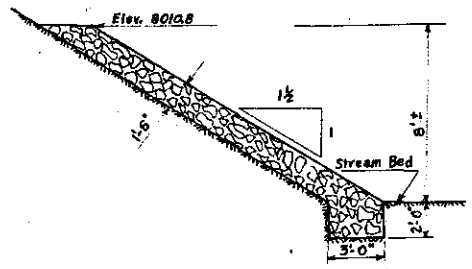
SUMMARY OF QUANTITIES

Item	Description	Unit	Super-structure	Abut. No. 1	Pier No. 2	Pier No. 3	Abut. No. 4	Totals
c	Unclassified Excavation	Cu. Yd.						146
	Common Excavation (Structural)	Cu. Yd.		62	29	29	66	186
	Structure Backfill (Class I)	Cu. Yd.		26	19	19	27	91
	Mechanical Tamping	Hrs.		6	2	2	6	16
	Station Yard Overhaul	Sta. Yd.						1000
	Yard Mile Overhaul	Yd. Mi.						30
	Treated Bridge Timber	Mft.bm.		.099			.099	.198
	Class "A" Concrete	Cu. Yd.	125.2	16.5	17.4	17.4	16.5	193
	Reinforcing Steel (incl. 1% ± for overrun)	Lbs.	34,755	1,755	1,505	1,505	1,755	41,275
	Structural Steel (incl. ½% ± for paint)	Lbs.	3,030		285	285		3,600
	Rip Rap (1'-6" thick)	Cu. Yd.		100			97	197
c	Metal Plate Guard Fence (Beam Type)	Lin. Ft.		25			25	50
x	Metal Plate Guard Rail (Beam Type)	Lin. Ft.	238					238
a	Drain Pipe (Conc. Floor 4"φ x 1'-6")	Each	12					12



STRUCTURE BACKFILL & MECHANICAL TAMPING DIAGRAM

All material that is to be mechanically tamped, shall be placed in horizontal layers not more than 6 inches in depth and tamped before the next layer is placed.



DETAIL OF RIPRAP

GENERAL NOTES

ALL WORK SHALL BE DONE ACCORDING TO THE STANDARD SPECIFICATIONS OF THE COLORADO DEPARTMENT OF HIGHWAYS APPLICABLE TO THE PROJECT.
ALL CONCRETE SHALL BE CLASS "A" AND AIR ENTRAINED AS SPECIFIED.
ALL CONCRETE SURFACES EXPOSED TO NORMAL VIEW BY HIGHWAY TRAFFIC SHALL RECEIVE CLASS 2 SURFACE FINISH. WING FACES SHALL RECEIVE ORDINARY SURFACE FINISH.
CONCRETE GIRDERS, FLOOR SLABS, AND CURBS SHALL BE POURED MONOLITHICALLY.
FORMS FOR CONCRETE SURFACES EXPOSED IN THE FINISHED WORK SHALL BE CONSTRUCTED OF SHIPLAP OR TONGUE AND GROOVE LUMBER S 2 S UNLESS FACED WITH PANEL BOARD.
FOOTINGS IN ROCK SHALL BE POURED OUT TO ROCK AND NOT FORMED.
SOUNDINGS AND DEPTH OF FOOTING SHOWN ARE IN ACCORDANCE WITH THE BEST AVAILABLE DATA AND WHEN DIFFERENT CONDITIONS ARE ENCOUNTERED THE BRIDGE ENGINEER WILL INSPECT AND DETERMINE IF REDESIGN IS NECESSARY.
ALL REINFORCING STEEL SHALL CONFORM TO ASTM SPECIFICATION A 305-50T OR THE LATEST REVISION THEREOF, AND SHALL BE INTERMEDIATE GRADE STEEL OF A DEFORMED TYPE. EACH BAR SHALL BE TAGGED WITH THE NUMBER DESIGNATION AND THE STATION NUMBER OF THE PROJECT. PRIMARY BARS SHALL NOT BE SPLICED AND SECONDARY BARS WHEN SPLICED SHALL LAP 20 DIAMETERS OF THE BAR. DIMENSIONS FOR REINFORCING STEEL NOT SHOWN AS CLEAR SHALL BE TO THE CENTER LINE OF THE BAR.
ALL STRUCTURAL STEEL SHALL BE PAINTED ONE SHOP COAT OF ZINC CHROMATE AND TWO FIELD COATS OF ALUMINUM, UNLESS OTHERWISE NOTED, EXCEPT THE UNEXPOSED PORTION OF STEEL PILING NEED NOT BE PAINTED.
HANDRAIL BOLTS SHALL HAVE HEX HEADS, NUTS, AND LOCK WASHERS UNLESS OTHERWISE SPECIFIED AND ALL RIVETS, EXCEPT AS NOTED ARE ¾" DIA. AND SHALL BE POWER DRIVEN.
WHEN TREATED TIMBER OR PILING IS SHOWN ON THE DRAWING THE PRESERVATIVE FOR TREATMENT SHALL BE CREOSOTE OIL.
WHEN EXCAVATING FOR FOOTINGS THE FINAL ONE FOOT IN DEPTH SHALL BE DONE BY HAND LABOR METHODS.
IF BY PERMISSION OF THE ENGINEER PRIMARY BARS ARE SPLICED, THEY SHALL LAP 34 DIAMETERS, FOR BARS NEAR TOP OF BEAMS AND GIRDERS HAVING MORE THAN 12 INCHES OF CONCRETE UNDER THE BARS AND 20 DIAMETERS FOR BARS NEAR BOTTOM OF MEMBERS.

STRUCTURE NO. K-8-D

LOADING DATA

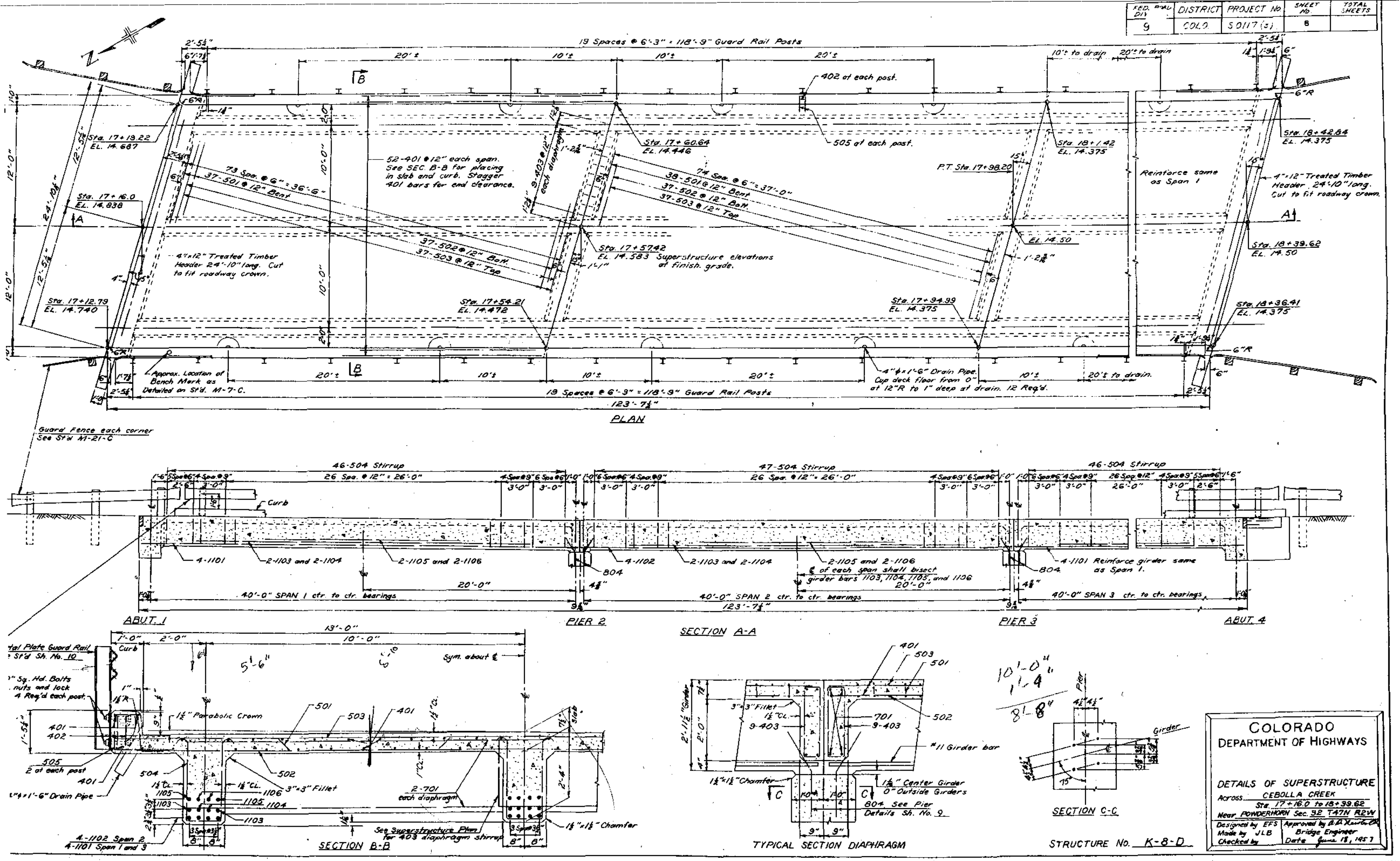
LIVE LOAD — A.A.S.H.O. (H20-S16-44)
DEAD LOAD ASSUMES 15 LBS. PER SQ. FT. ADDITIONAL WEARING SURFACE WHICH INCLUDES THE ½ INCH CONCRETE MONOLITHIC WEARING SURFACE SHOWN.

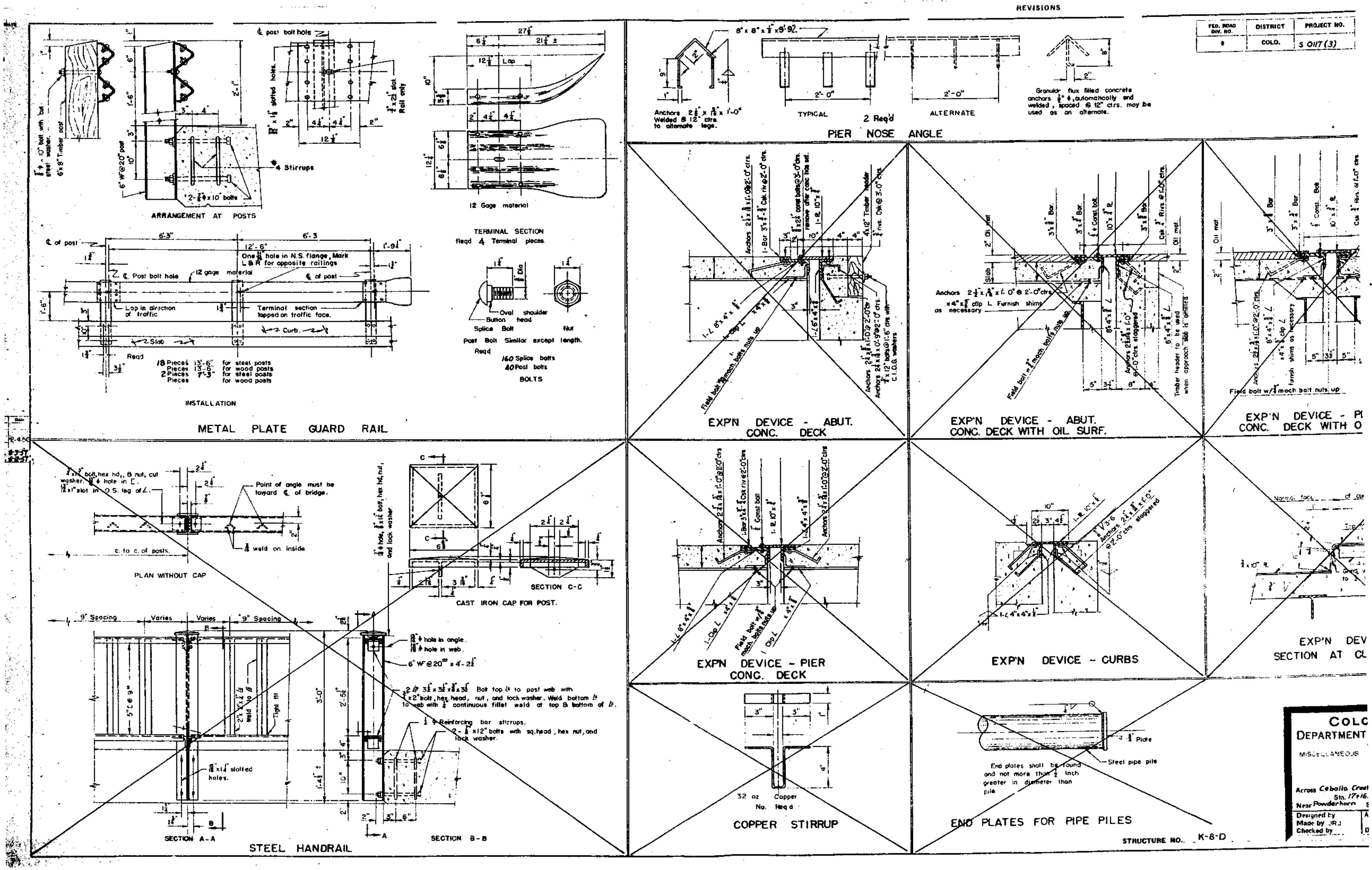
DESIGNING DATA

A.A.S.H.O. 1953 UNIT STRESSES, EXCEPT AS NOTED.
Reinforcing Steel fs = 20000 lbs. per sq. in.
Structural Steel fs = 18000 lbs. per sq. in.
fc = 1200 lbs. per sq. in.
n = 10

COLORADO
DEPARTMENT OF HIGHWAYS
3 SPANS @ 40' CONCRETE SLAB & GIRDER BRIDGE, 24' RDWY., 1'-0" CURBS, 15° SKEW
GENERAL LAYOUT, BAR LISTS, TAMPING DIAGRAM, SUMMARY OF QUANTITIES,
Across Cebolla Creek
Sta. 17+16.0 to 18+39.62
Near Powderhorn Sec. 32 T. 47N. R. 2W.

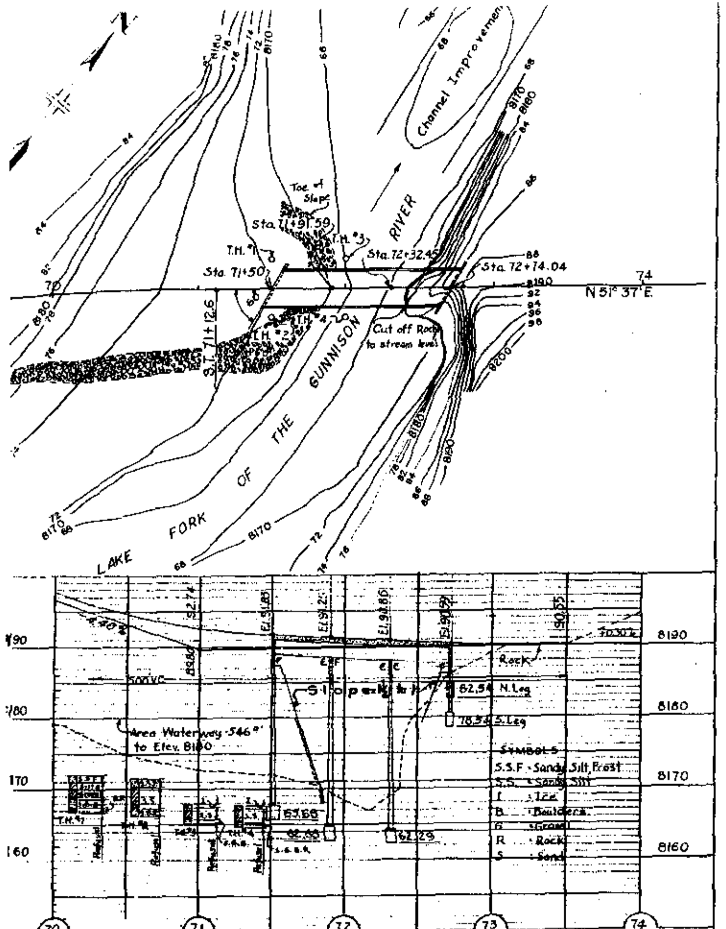
Designed by E.F.S.	Approved by [illegible]
Made by J.L.B.	Bridge Engineer
Checked by	Date: June 18, 1957


FED. ROAD DIV. 9 | DISTRICT COLO. | PROJECT No. S 0117 (3) | SHEET No. 8 | TOTAL SHEETS
19 Spaces @ 6'-3" = 118'-9" Guard Rail Posts
402 at each post.
505 at each post.
Sta. 17+19.22 EL. 14.687
Sta. 17+60.64 EL. 14.446
Sta. 18+1.42 EL. 14.375
Sta. 18+42.84 EL. 14.375
P.T. Sta. 17+98.20
Reinforce same as Span 1
4"x12" Treated Timber Header 24'-10" long. Cut to fit roadway crown.
52-401 @ 12" each span. See SEC. B-B for placing in slab and curb. Stagger 401 bars for end clearance.
73 Spa. @ 6" = 36'-6"
37-501 @ 12" Bent
74 Spa. @ 6" = 37'-0"
38-501 @ 12" Bent
37-502 @ 12" Bott.
37-503 @ 12" Top
9-403 @ 12" each diaphragm
Sta. 17+16.0 EL. 14.838
Sta. 17+57.42 EL. 14.583 Superstructure elevations at finish grade.
EL. 14.50
Sta. 18+39.62 EL. 14.50
Sta. 17+12.79 EL. 14.740
Sta. 17+54.21 EL. 14.472
Sta. 17+94.99 EL. 14.375
Sta. 18+36.41 EL. 14.375
Approx. Location of Bench Mark as Detailed on St'd. M-7-C.
4"φx1'-6" Drain Pipe. Cup deck floor from 0" at 12"R to 1" deep at drain. 12 Req'd.
10'± to drain 20'± to drain
123'-7½"
PLAN
Guard Fence each corner See St'd M-21-C
46-504 Stirrup
47-504 Stirrup
26 Spa. @ 12" = 26'-0"
Curb
4-1101
2-1103 and 2-1104
2-1105 and 2-1106
804
4-1102
℄ of each span shall bisect girder bars 1103, 1104, 1105, and 1106
4-1101 Reinforce girder same as Span 1.
40'-0" SPAN 1 ctr. to ctr. bearings
40'-0" SPAN 2 ctr. to ctr. bearings
40'-0" SPAN 3 ctr. to ctr. bearings
ABUT. 1
PIER 2
PIER 3
ABUT. 4
SECTION A-A
Metal Plate Guard Rail See St'd Sh. No. 10
Sq. Hd. Bolts nuts and lock 4 Req'd each post.
1½" Parabolic Crown
Sym. about ℄
13'-0"
10'-0"
505 2 at each post
4"φx1'-6" Drain Pipe
3"x3" Fillet
2-701 each diaphragm
4-1102 Span 2
4-1101 Span 1 and 3
See Superstructure Plan for 403 diaphragm stirrup
1½"x1½" Chamfer
SECTION B-B
Girder
3"x3" Fillet
9-403
#11 Girder bar
1½"x1½" Chamfer
1½" Center Girder 0" Outside Girders
804 See Pier Details Sh. No. 9
TYPICAL SECTION DIAPHRAGM
SECTION C-C
10'-0"
1'-4"
8'-8"
STRUCTURE No. K-8-D
COLORADO
DEPARTMENT OF HIGHWAYS
DETAILS OF SUPERSTRUCTURE
Across CEBOLLA CREEK
Sta. 17+16.0 to 18+39.62
Near POWDERHORN Sec. 32 T47N R2W
Designed by EFS
Made by JLB
Checked by
Approved by
Bridge Engineer
Date June 18, 1957


REVISIONS
FED. ROAD DIV. NO. | DISTRICT | PROJECT NO.
9 | COLO. | S 0117(3)
ARRANGEMENT AT POSTS
4 Stirrups
2-5/8" φ x 10" bolts
12 Gage material
TERMINAL SECTION
Reqd 4 Terminal pieces.
One hole in N.S. flange, Mark L & R for opposite railings
12 gage material
Post bolt hole
Lap in direction of traffic
Terminal section lapped on traffic face.
Curb.
Slab
18 Pieces 13'-6" for steel posts
Pieces 13'-6" for wood posts
2 Pieces 7'-3" for steel posts
Pieces for wood posts
INSTALLATION
Oval shoulder
Button head
Splice Bolt
Nut
Post Bolt Similar except length.
160 Splice bolts
40 Post bolts
BOLTS
METAL PLATE GUARD RAIL
Anchors 2½" x 3/8" x 1'-0" Welded @ 12" ctrs. to alternate legs.
TYPICAL
2 Req'd
ALTERNATE
Granular flux filled concrete anchors, automatically end welded, spaced @ 12" ctrs. may be used as an alternate.
PIER NOSE ANGLE
EXP'N DEVICE - ABUT. CONC. DECK
EXP'N DEVICE - ABUT. CONC. DECK WITH OIL SURF.
EXP'N DEVICE - PI
CONC. DECK WITH O
Point of angle must be toward ℄ of bridge.
weld on inside
c. to c. of posts.
PLAN WITHOUT CAP
SECTION C-C
CAST IRON CAP FOR POST.
9" Spacing
Varies
Varies
9" Spacing
6" WF @ 20# x 4'-2½"
Reinforcing bar stirrups.
slotted holes.
SECTION A-A
SECTION B-B
STEEL HANDRAIL
EXP'N DEVICE - PIER CONC. DECK
EXP'N DEVICE - CURBS
EXP'N DEV
SECTION AT CU
32 oz Copper
No. Req'd
COPPER STIRRUP
End plates shall be round and not more than ½ inch greater in diameter than pile.
Steel pipe pile
END PLATES FOR PIPE PILES
STRUCTURE NO. K-8-D
COLO
DEPARTMENT
MISCELLANEOUS
Across Cebolla Creek
Near Powderhorn
Designed by
Made by JRJ
Checked by

FED. ROAD DIV. NO.	DISTRICT	PROJECT NO.	SHEET NO.	TOT. SHE
9	COLO.	50 117(2)	8	

Rev. 6-29-56 JVG Bar bending diagram



GENERAL LAYOUT

BAR LIST-SUPERSTRUCTURE

Mark	Size	No. Req'd	Length	Type	Dimensions ℓ	m
460	½"φ	153	30'-0"	Str.		
461	½"φ	98	12'-0"	Str.		
462	½"φ	80	6'-1"	III	2'-3½"	6"
463	½"φ	55	11'-9"	Str.		
464	½"φ	24	21'-6"	Str.		
465	½"φ	108	1'-9"	IX	4"	1'-1"
466	½"φ	80	4'-0"	III	1'-1"	8"
501	⅝"φ	102	30'-7"	I		
502	⅝"φ	104	31'-9"	II		
503	⅝"φ	104	29'-9½"	Str.		
504	⅝"φ	417	7'-3"	VI		
505	⅝"φ	80	2'-11"	IX		
701	⅞"φ	16	24'-0"	Str.		
1101	1⅜"φ	24	43'-11"	VIII	41'-1"	
1102	1⅜"φ	12	43'-2¼"	VIII	40'-4¼"	
1103	1⅜"φ	18	31'-6"	Str.		
1104	1⅜"φ	18	25'-0"	Str.		
1105	1⅜"φ	18	18'-4"	Str.		
1106	1⅜"φ	18	11'-0"	Str.		

BAR SUMMARY-SUPERST'TURE

7,924 lin.ft. ½"φ @ 0.668#/lin.ft. = 5,293 lbs.
12,776 " " ⅝"φ @ 1.043 " " = 13,325 "
384 " " ⅞"φ @ 2.044 " " = 785 "
3,118 " " 1⅜"φ @ 5.313 " " = 16,566 "
Plus 1% Overrun = 361 "
Total = 36,330 "

BAR LIST - PIER NO.2
(PIER NO.3 SAME)

Mark	Size	No. Req'd	Length	Type	Dimensions ℓ	m
402	½"φ	1	8'-0"	Str.		
403	½"φ	1	22'-9"	Str.		
404	½"φ	34	17'-0"	Str.		
405	½"φ	14	33'-0"	IV	16'-2"	0'-8"
406	½"φ	70	7'-4"	III	2'-1"	1'-3"
407 to 425	½"φ	1 ea.	8'-3" by 2" to 11'-6½"	V	1'-9¼" by ¼" to 2'-6¾"	1'-8" by ¼" to 2'-5"
426 to 444	½"φ	1 ea.	7'-4" by 2" to 10'-4"	III	1'-8" by ¼" to 2'-5"	1'-8" by ¼" to 2'-5"
445 to 451	½"φ	1 ea.	2'-4" by 1½" to 3'-1"	IV	0'-4"	1'-8" by 1½" to 2'-5"
508	⅝"φ	28	5'-8"	Str.		
601	¾"φ	6	9'-9"	VII		
901	1⅛"φ	3	6'-6"	Str.		
902	1⅛"φ	4	29'-8"	Str.		
1001	1¼"φ	6	9'-0"	Str.		
1002	1¼"φ	4	29'-8"	Str.		
1003	1¼"φ	4	13'-7"	Str.		
1004	1¼"φ	4	18'-7"	Str.		
1101	1⅜"φ	16	4'-0"	Str.		
1102	1⅜"φ	8	22'-9"	Str.		

BAR SUMMARY - PIER NO.2
(PIER NO.3 SAME)

1954 lin.ft. ½"φ @ 0.668#/lin.ft. = 1305 lbs
59 " " ¾"φ @ 1.502 " " " = 89 "
138 " " 1⅛"φ @ 3.400 " " " = 469 "
301 " " 1¼"φ @ 4.303 " " " = 1295 "
246 " " 1⅜"φ @ 5.313 " " " = 1307 "
159 " " ⅝"φ @ 1.043 " " " 166 "
Plus 1% Overrun = 44 "
Total 4675 "

BAR LIST-ABUTMENT NO. 4

Mark	Size	No. Req'd	Length	Type	Dimensions ℓ	m
478	½"φ	2	5'-0"	Str.	(Field	bend)
479	½"φ	4	4'-0"	Str.	("	")
484	½"φ	2	2'-10"	Str.		
485	½"φ	2	3'-4"	Str.		
490	½"φ	7	4'-3"	Str.		
491	½"φ	6	5'-7"	Str.		
492	½"φ	7	4'-9"	Str.		
493	½"φ	14	2'-0"	Str.		
494	½"φ	2	7'-5½"	III	1'-8¾"	1'-8"
495	½"φ	2	7'-8½"	III	1'-10¼"	1'-8"
496 to 499	½"φ	1 ea.	7'-11¾" by 3" to 8'-8¾"	III	1'-11¾" by 1½" to 2'-4¼"	1'-8"
4100	½"φ	28	11'-0½"	I	2'-8¾"	9½"
4101	½"φ	2	12'-8½"	XI	2'-2¼"	
4102	½"φ	1	12'-10"	XI	2'-3"	
516	⅝"φ	2	36'-8"	Str.		
520	⅝"φ	7	6'-0"	Str.		
521	⅝"φ	4	10'-0"	Str.		
522	⅝"φ	11	5'-7"	Str.		
710	⅞"φ	3	10'-0"	Str.		
801	1"φ	4	29'-9"	Str.		
802	1"φ	3	32'-8"	Str.		
803	1"φ	1	36'-8"	Str.		

BAR SUMMARY-ABUT. NO.4

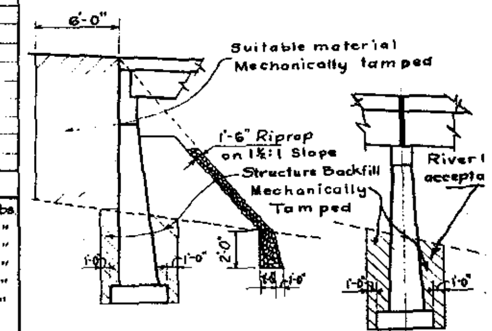
584 lin.ft. ½"φ @ 0.668#/lin.ft. = 390 lbs
216 " " ⅝"φ @ 1.043 " " " = 225 "
30 " " ⅞"φ @ 2.044 " " " = 61 "
254 " " 1"φ @ 2.670 " " " = 678 "
Plus 1% Overrun = 11 "
Total = 1365 "

BAR LIST-ABUTMENT NO.1

Mark	Size	No. Req'd	Length	Type	Dimensions ℓ	m
470	½"φ	20	3'-0"	Str.		
471	½"φ	10	6'-2"	Str.		
472	½"φ	14	10'-5"	III	3'-2½"	1'-8"
473	½"φ	18	8'-5"	III	2'-2½"	1'-8"
474	½"φ	6	6'-5"	III	1'-2½"	1'-8"
475	½"φ	2	17'-6"	Str.		
476	½"φ	15	6'-4"	III	1'-8"	1'-2"
477	½"φ	29	11'-1½"	I	2'-10¾"	8½"
478	½"φ	2	5'-0"	Str.	(Field	bend)
479	½"φ	4	4'-0"	Str.	(Field	bend)
480	½"φ	1	3'-0"	Str.		
481	½"φ	1	3'-6"	Str.		
482	½"φ	1	12'-9½"	XI	2'-2¼"	
483	½"φ	2	13'-3"	XI	2'-5¼"	
484	½"φ	1	2'-10"	Str.		
485	½"φ	1	3'-4"	Str.		
511	⅝"φ	14	6'-2"	Str.		
512	⅝"φ	8	3'-7"	Str.		
513	⅝"φ	4	22'-0"	Str.		
514	⅝"φ	4	15'-9"	Str.		
515	⅝"φ	4	8'-9"	Str.		
516	⅝"φ	2	36'-8"	Str.		
601	¾"φ	6	9'-9"	VII		
602	¾"φ	20	8'-7"	Str.		
603	¾"φ	8	6'-2"	Str.		
705	⅞"φ	8	17'-6"	Str.		
801	1"φ	4	29'-9"	Str.		
802	1"φ	3	32'-8"	Str.		
803	1"φ	1	36'-8"	Str.		
905	1⅛"φ	8	3'-7"	Str.		
906	1⅛"φ	4	22'-0"	Str.		
907	1⅛"φ	4	13'-9"	Str.		
908	1⅛"φ	4	9'-5"	Str.		

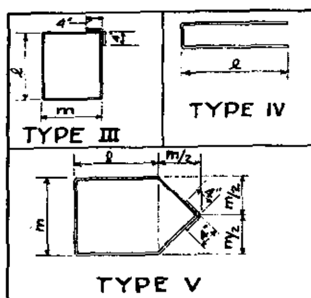
BAR SUMMARY-ABUT. NO.1

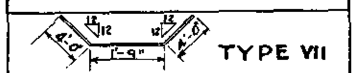
988 Lin.ft. ½"φ @ 0.668#/ft. = 660 lbs.
374 " " ⅝"φ @ 1.043 " " = 390 "
280 " " ¾"φ @ 1.502 " " = 421 "
140 " " ⅞"φ @ 2.044 " " = 286 "
254 " " 1"φ @ 2.670 " " = 678 "
209 " " 1⅛"φ @ 3.400 " " = 711 "
Plus 1% Overrun 30 "
Total = 3175 lbs

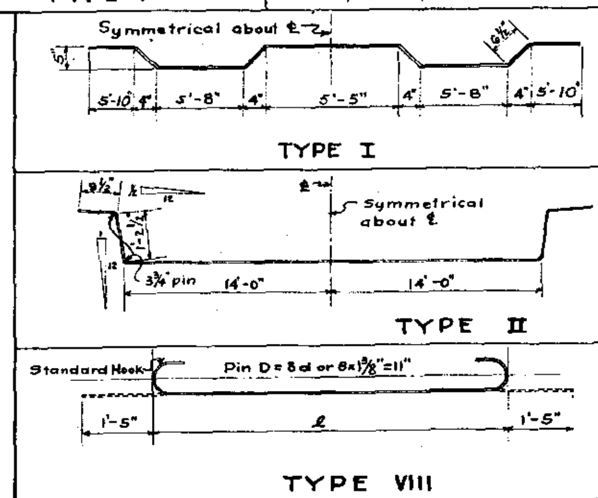


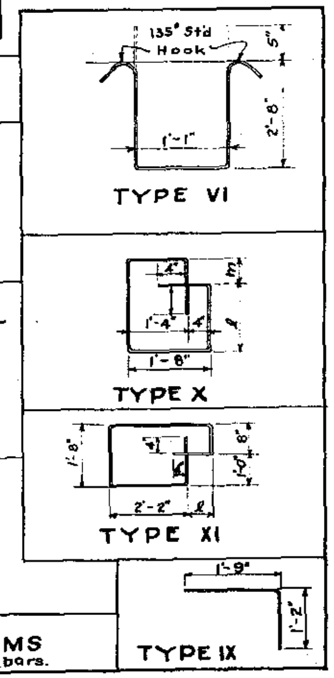
ABUTMENT
PIER

STRUCTURE BACKFILL & MECHANICAL TAMPING DIAGRA









BENDING DIAGRAMS
All dimensions are out to out of bars.

SUMMARY OF QUANTITIES

Item	Description	Unit	Superstr.	Abut. #1	Pier #2	Pier #3	Abut. #4	Total
4a	Dry Rock Excavation (Str.)	Cu.Yd.					13	13
4b	Dry Common Excavation (Str.)	Cu.Yd.		39	11	25	13	88
4c	Wet Rock Excavation (Str.)	Cu.Yd.		11	10	14		35
4d	Wet Common Excavation (Str.)	Cu.Yd.			24	24		48
6a	Structure Backfill	Cu.Yd.		34	32	43	19	128
6c	Mechanical Tamping	Hrs.		20	3	4	5	32
13c	Unclassified Excavation	Cu.Yd.						500
8a	Station Yard Overhaul	Sta.Yd.						1408
8b	Yard Mile Overhaul	Yd.Mi.						233
2b	Treated Bridge Timber	Mft.bm.	0.288	0.112			0.112	0.512
6a	Class "A" Concrete	Cu.Yd.	127	29	30	29	15	230
7	Reinforcing Steel (+1% overrun)	Lbs.	36,330	3175	4675	4675	1365	50,220
8	Structural Steel (+½% for Paint)	Lbs.	3560		505	505		4570
7a	Rip Rap (1'-0" thick)	Cu.Yd.		180				180
5a	Metal Plate Guard Fence (Beam Type 2)	Lin.ft.	288					288
0c	Sheet Copper (32 oz.)	Lbs.	8					8
9a	Drain Pipe (Conc.Floor)(4"φ x 1'-6")	Each	6					6
	1" Expansion Joint Mat'l Type I	Sq.ft.	136					136

Structural Steel includes 2575 lbs. of Handrail Steel.
Expansion Joint Material shall be included in bid price of Class "A" Concrete and shall be according to AASHO specifications M-153-54.

GENERAL NOTES

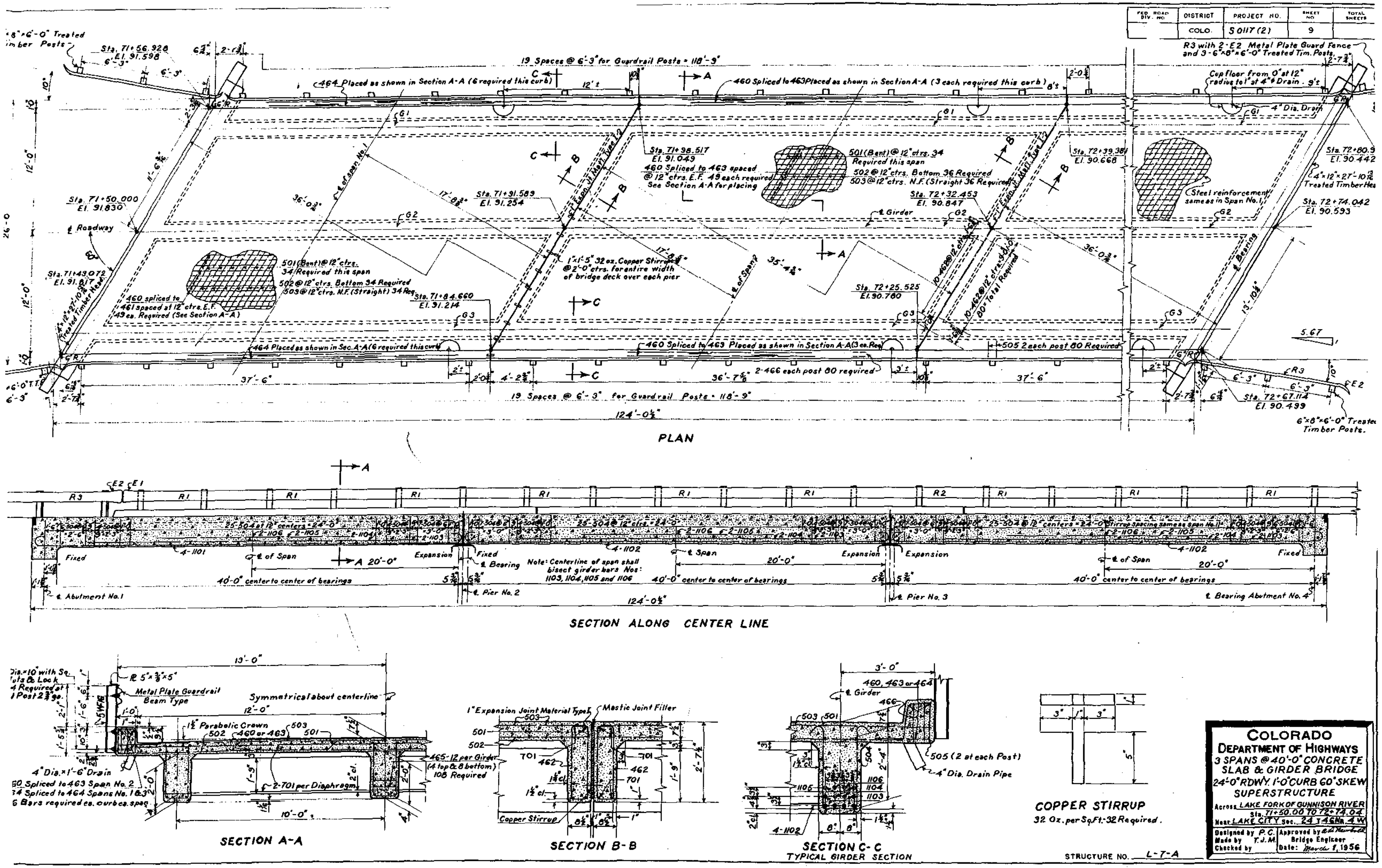
ALL WORK SHALL BE DONE ACCORDING TO THE STANDARD SPECIFICATIONS OF THE COLORADO DEPARTMENT OF HIGHWAYS APPLICABLE TO THE PROJECT.
ALL CONCRETE SHALL BE CLASS "A" AND AIR ENTRAINED AS SPECIFIED.
ALL CONCRETE SURFACES EXPOSED TO VIEW SHALL RECEIVE CLASS "1" SURFACE FINISH, EXCEPT THE UNDERSIDE OF FLOOR SLABS AND ABUTMENT FACES BETWEEN OUTSIDE STRINGERS.
CONCRETE GIRDERS, FLOOR SLABS, AND CURBS SHALL BE POURED MONOLITHICALLY.
FORMS FOR CONCRETE SURFACES EXPOSED IN THE FINISHED WORK SHALL BE CONSTRUCTED OF SHIPLAP OR TONGUE AND GROOVE LUMBER S 3 S UNLESS FACED WITH PANEL BOARD.
FOOTINGS IN ROCK SHALL BE POURED OUT TO ROCK AND NOT FORMED.
SOUNDINGS AND DEPTH OF FOOTING SHOWN ARE IN ACCORDANCE WITH THE BEST AVAILABLE DATA AND WHEN DIFFERENT CONDITIONS ARE ENCOUNTERED THE BRIDGE ENGINEER WILL INSPECT AND DETERMINE IF REDESIGN IS NECESSARY.
ALL REINFORCING STEEL SHALL CONFORM TO ASTM SPECIFICATION A 305-50T OR THE LATEST REVISION THEREOF, AND SHALL BE INTERMEDIATE GRADE STEEL OF A DEFORMED TYPE. EACH BAR SHALL BE TAGGED WITH THE NUMBER DESIGNATION AND THE STATION NUMBER OF THE PROJECT. PRIMARY BARS SHALL NOT BE SPLICED AND SECONDARY BARS WHEN SPLICED SHALL LAP 20 DIAMETERS OF THE BAR. DIMENSIONS FOR REINFORCING STEEL NOT SHOWN AS CLEAR SHALL BE TO THE CENTER LINE OF THE BAR.
ALL STRUCTURAL STEEL SHALL BE PAINTED ONE SHOP COAT OF ZINC CHROMATE AND TWO FIELD COATS OF ALUMINUM, UNLESS OTHERWISE NOTED, EXCEPT THE UNEXPOSED PORTION OF STEEL PILING NEED NOT BE PAINTED.
HANDRAIL BOLTS SHALL HAVE HEX HEADS, NUTS, AND LOCK WASHERS UNLESS OTHERWISE SPECIFIED AND ALL RIVETS, EXCEPT AS NOTED ARE ¾" DIA. AND SHALL BE POWER DRIVEN.
WHEN TREATED TIMBER OR PILING IS SHOWN ON THE DRAWING THE PRESERVATIVE FOR TREATMENT SHALL BE CREOSOTE OIL.
WHEN EXCAVATING FOR FOOTINGS THE FINAL ONE FOOT IN DEPTH SHALL BE DONE BY HAND LABOR METHODS.

STRUCTURE NO. L-7-A

LOADING DATA
LIVE LOAD - A.A.S.H.O. (H-20-44)
DEAD LOAD ASSUMES 15 LBS. PER SQ. FT. ADDITIONAL W SURFACE WHICH INCLUDES THE ½ INCH CONCRETE MON WEARING SURFACE SHOWN.

DESIGNING DATA
A.A.S.H.O. 1953 UNIT STRESSES, EXCEPT AS NOTED.
Reinforcing Steel fs 20000 lbs. per sq. in.
Structural Steel fs 18000 lbs. per sq. in.
fc 1200 lbs. per sq. in.
n 10

COLORADO
DEPARTMENT OF HIGHWAY:
3 SPANS @ 40'-0" CONCRETE SLAB
4 GIRDER BRIDGE
24'-0" RDWY 1'-0" CURB 60° SKEW
GENERAL LAYOUT
Across Lake Fork of the Gunnison River
Sta. 71+50.00 to 72+74.04
Near Lake City Sec. 24 T.46 N. R.4
Designed by P.C.
Made by A.E.S.
Checked by
Approved by [signature]
Bridge Engineer
Date: March 8, 1956



FED. ROAD DIV. NO.
DISTRICT
PROJECT NO.
SHEET NO.
TOTAL SHEETS
COLO.
S 0117 (2)
9
PLAN
19 Spaces @ 6'-3" for Guardrail Posts = 118'-9"
124'-0½"
SECTION ALONG CENTER LINE
40'-0" center to center of bearings
Abutment No. 1
Pier No. 2
Pier No. 3
Bearing Abutment No. 4
Note: Centerline of span shall bisect girder bars Nos: 1103, 1104, 1105 and 1106
SECTION A-A
Symmetrical about centerline
Metal Plate Guardrail Beam Type
Parabolic Crown
4" Dia. x 1'-6" Drain
465-12 per Girder (4 top & 8 bottom) 108 Required
SECTION B-B
1" Expansion Joint Material Type I
Mastic Joint Filler
Copper Stirrup
SECTION C-C
TYPICAL GIRDER SECTION
505 (2 at each Post)
4" Dia. Drain Pipe
COPPER STIRRUP
32 Oz. per Sq. Ft. 32 Required.
COLORADO
DEPARTMENT OF HIGHWAYS
3 SPANS @ 40'-0" CONCRETE SLAB & GIRDER BRIDGE
24'-0" RDWY. 1'-0" CURB 60° SKEW
SUPERSTRUCTURE
Across LAKE FORK OF GUNNISON RIVER
Sta. 71+50.00 TO 72+74.04
Near LAKE CITY Sec. 24 T 46N R 4 W
Designed by P. C.
Made by T. J. M.
Checked by
Approved by
Bridge Engineer
Date: March 1, 1956
STRUCTURE NO. L-7-A

Appendix G – Sediment Size Analysis

Two sediment samples were collected from the channel bed near Bridge C-09-AR. Results of the sediment size analysis for the sediment sample collected from the channel are presented below in both tabular and graphical formats.

Figure G.1.1.
Photo of sediment sample from the C-09-AR site

Table G.1.1.
Sediment sieve analysis
Sample ID: C-09-AR Yampa River
Sample Description: 1 of 2
Performed by: JE
Date: 8-15-2012

Sieve Size (mm)	% Finer
44.45	100%
16	84%
8	70%
4	61%
2	52%
1	30%
0.5	10%
0.25	3%

Figure G.1.2.

Grain size gradation curve for the sediment sample collected from Yampa River in the vicinity of C-09-AR

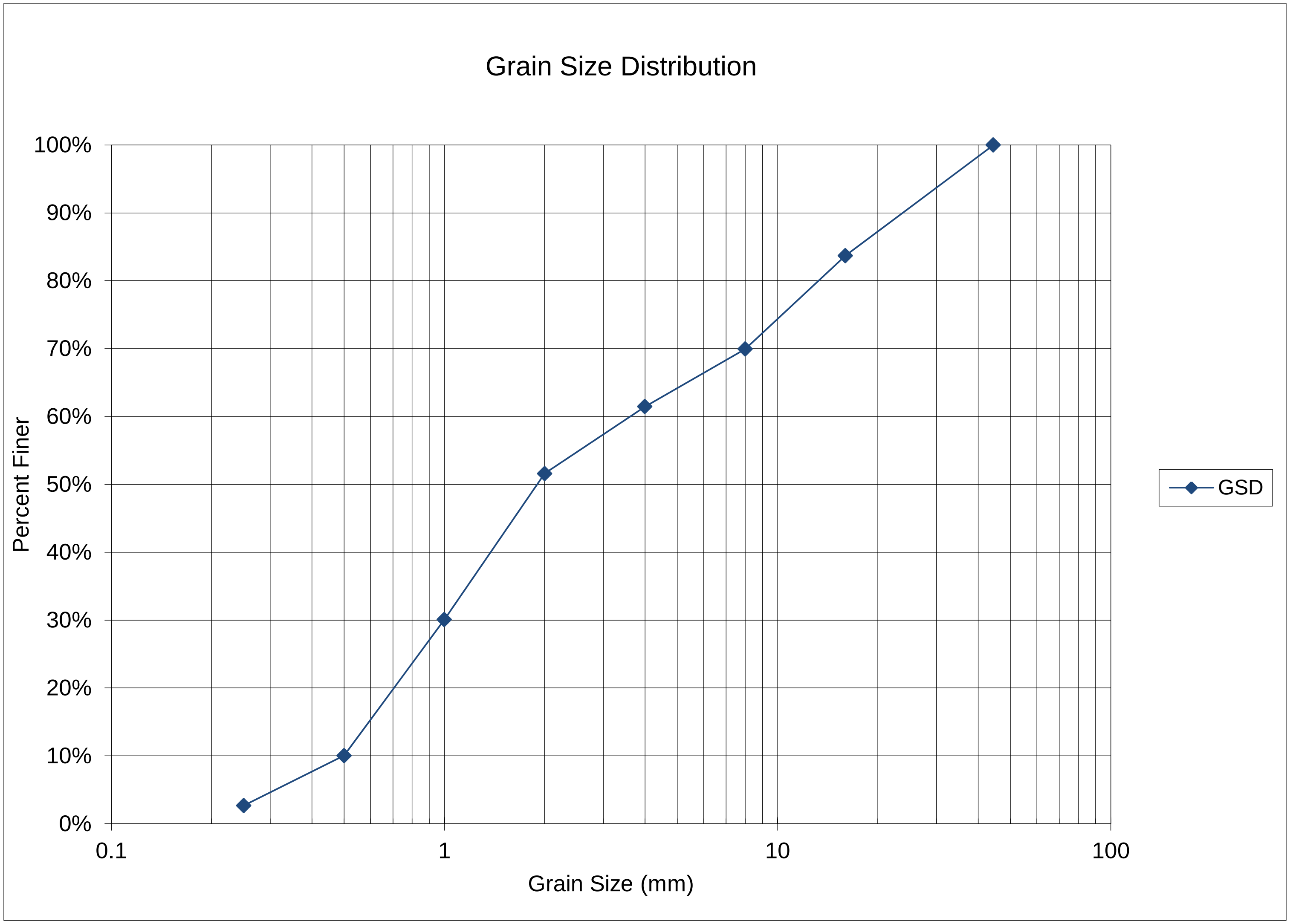


Table G.1.2.

Grain size gradation computations for the sediment sample collected from Yampa River in the vicinity of C-09-AR

Structure # C-09-AR	**Waterbody - Yampa River**	**Sample # 1 of 2**	Performed by: JE			
			Date: 8/15/2012			
Sieve Size (mm)	Weight of Sieve (g)	Weight of Sieve + Soil (g)	Weight of Soil (g)	% Retained	Cumulative % Ret.	% Finer
44.45	0	0	0	0%	0%	100%
16	536.47	799.23	262.76	16%	16%	84%
8	550.36	772.03	221.67	14%	30%	70%
4	507.95	644.52	136.57	8%	39%	61%
2	474	633.06	159.06	10%	48%	52%
1	430.41	776.83	346.42	21%	70%	30%
0.5	413.58	736.96	323.38	20%	90%	10%
0.25	392.83	511.28	118.45	7%	97%	3%
Pan	377.86	421.18	43.32	3%	100%	0%
		Total Weight of Sample	**1611.63**			

Figure G.1.3.
Photo of sediment sample from the C-09-AR site

Table G.1.3.
Sediment sieve analysis
Sample ID: C-09-AR Yampa River
Sample Description: 2 of 2
Performed by: JE
Date: 8-15-2012

Sieve Size (mm)	% Finer
44.45	100%
8	63%
4	53%
2	43%
1	28%
0.5	8%
0.25	1%
0.125	0%

Figure G.1.4.

Grain size gradation curve for the sediment sample collected from Yampa River in the vicinity of C-09-AR

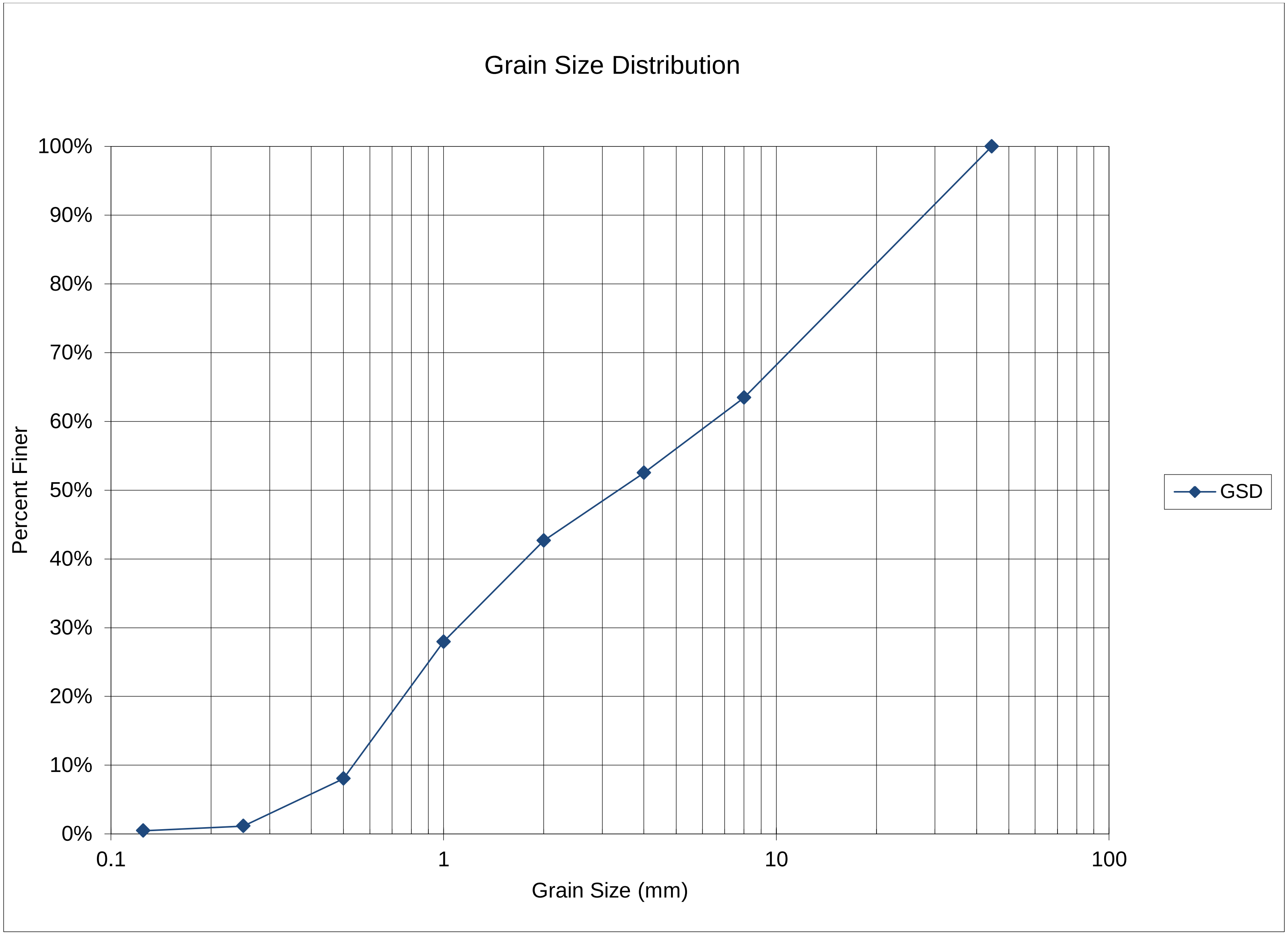


Table G.1.4.

Grain size gradation computations for the sediment sample collected from Yampa River in the vicinity of C-09-AR

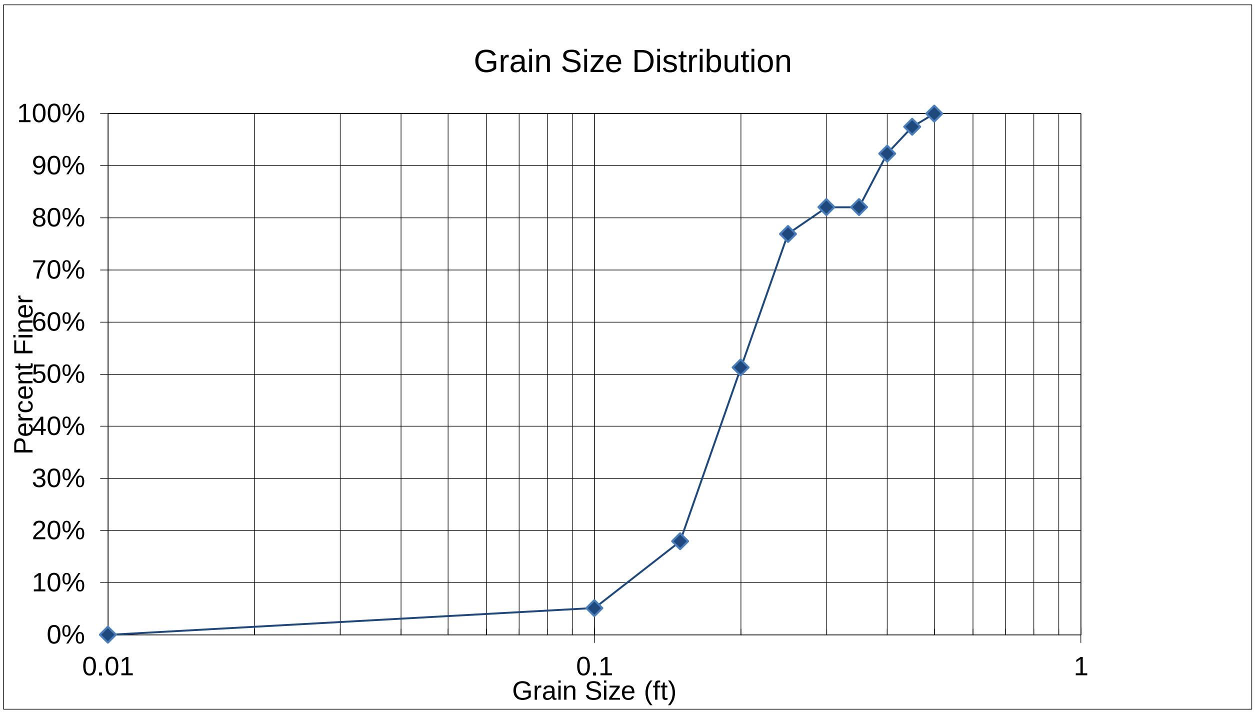
Structure # C-09-AR	**Waterbody - Yampa River**	**Sample # 2 of 2**	Performed by: JE Date: 8/15/2012			
Sieve Size (mm)	Weight of Sieve (g)	Weight of Sieve + Soil (g)	Weight of Soil (g)	% Retained	Cumulative % Ret.	% Finer
44.45	0	0	0	0%	0%	100%
8	550.36	1280.1	729.74	37%	37%	63%
4	507.95	726.28	218.33	11%	47%	53%
2	474	670.62	196.62	10%	57%	43%
1	430.41	724.28	293.87	15%	72%	28%
0.5	413.58	811.17	397.59	20%	92%	8%
0.25	392.83	530.53	137.7	7%	99%	1%
0.125	376.43	389.62	13.19	1%	100%	0%
Pan	373.86	383.3	9.44	0%	100%	0%
		Total Weight of Sample	**1996.48**			

Pebble Count Grain Size Distribution

Region	Structure ID	County	Facility Carried	Mile Marker	POA Fiscal Year	Feature Intersected	D_{50} min from POA	D_{50} max from POA
3	C-09-AR	Routt	SH 131 ML	64.5	2013	Yampa River	1.9	3.4

Sample #	A (ft)	B (ft)	C (ft)	Shape Factor	D_s (ft)	D_{avg} (ft)	Volume (ft³)
1	0.38	0.36	0.03	0.081	0.36	0.257	0.002
2	0.18	0.1	0.05	0.373	0.1	0.110	0.000
3	0.5	0.27	0.04	0.109	0.27	0.270	0.003
4	0.06	0.04	0.02	0.408	0.04	0.040	0.000
5	0.67	0.38	0.26	0.515	0.38	0.437	0.035
6	0.3	0.16	0.09	0.411	0.16	0.183	0.002
7	0.27	0.12	0.03	0.167	0.12	0.140	0.001
8	0.38	0.18	0.12	0.459	0.18	0.227	0.004
9	0.19	0.18	0.11	0.595	0.18	0.160	0.002
10	0.28	0.17	0.08	0.367	0.17	0.177	0.002
11	0.28	0.21	0.18	0.742	0.21	0.223	0.006
12	0.24	0.2	0.04	0.183	0.2	0.160	0.001
13	0.36	0.26	0.09	0.294	0.26	0.237	0.004
14	0.45	0.44	0.17	0.382	0.44	0.353	0.018
15	0.43	0.39	0.13	0.317	0.39	0.317	0.011
16	0.39	0.24	0.2	0.654	0.24	0.277	0.010
17	0.69	0.44	0.37	0.672	0.44	0.500	0.059
18	0.23	0.15	0.08	0.431	0.15	0.153	0.001
19	0.55	0.45	0.18	0.362	0.45	0.393	0.023
20	0.23	0.16	0.07	0.365	0.16	0.153	0.001
21	0.38	0.19	0.12	0.447	0.19	0.230	0.005
22	0.29	0.17	0.1	0.450	0.17	0.187	0.003
23	0.34	0.24	0.04	0.140	0.24	0.207	0.002
24	0.15	0.11	0.06	0.467	0.11	0.107	0.001
25	0.22	0.17	0.06	0.310	0.17	0.150	0.001
26	0.54	0.36	0.22	0.499	0.36	0.373	0.022
27	0.23	0.2	0.09	0.420	0.2	0.173	0.002
28	0.25	0.24	0.05	0.204	0.24	0.180	0.002
29	0.2	0.09	0.04	0.298	0.09	0.110	0.000
30	0.23	0.2	0.17	0.793	0.2	0.200	0.004
31	0.3	0.18	0.09	0.387	0.18	0.190	0.003
32	0.22	0.13	0.09	0.532	0.13	0.147	0.001
33	0.34	0.24	0.16	0.560	0.24	0.247	0.007
34	0.26	0.21	0.14	0.599	0.21	0.203	0.004
35	0.37	0.22	0.21	0.736	0.22	0.267	0.009
36	0.27	0.18	0.05	0.227	0.18	0.167	0.001
37	0.15	0.09	0.04	0.344	0.09	0.093	0.000
38	0.2	0.14	0.1	0.598	0.14	0.147	0.001
39	0.21	0.18	0.15	0.772	0.18	0.180	0.003
40	0.27	0.15	0.13	0.646	0.15	0.183	0.003

Structure # C-09-AR	Yampa River at SH 131			
Sieve Size (ft)	Samples Retained	% Retained	Cumulative % Ret.	% Finer
0.5	0	0%	0%	100%
0.45	1	3%	3%	97%
0.4	2	5%	8%	92%
0.35	4	10%	18%	82%
0.3	0	0%	18%	82%
0.25	2	5%	23%	77%
0.2	10	26%	49%	51%
0.15	13	33%	82%	18%
0.1	5	13%	95%	5%
0.01	2	5%	100%	0%
Total Samples	39			



Hydraulic Analysis Report

Project Data

Project Title: C-09-AR

Designer:

Project Date: Friday, September 13, 2013

Project Units: U.S. Customary Units

Notes:

Wolman Count Analysis: Gradation Analysis

Notes:

Image Gradation Input Parameters

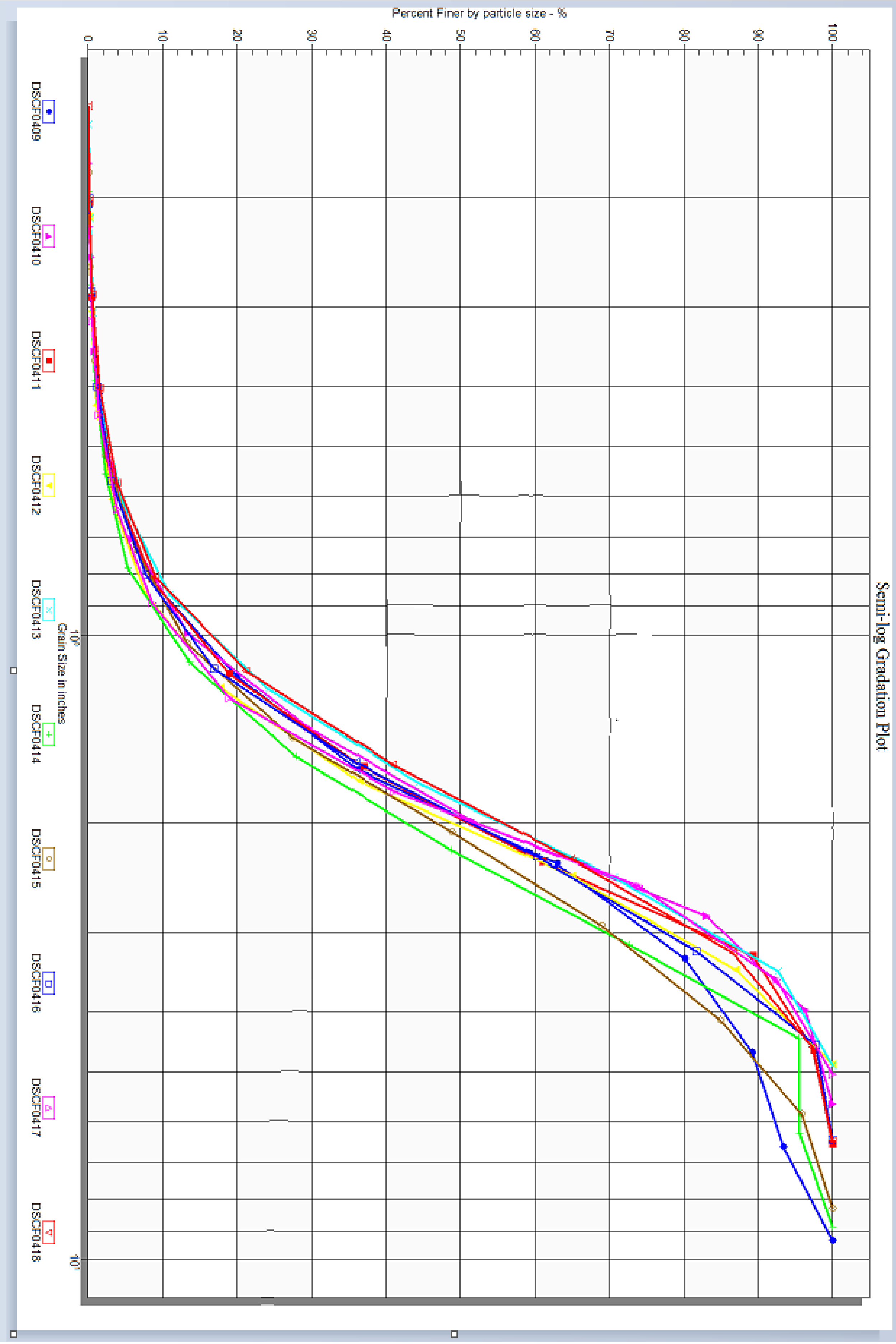
Name: DSCF0409

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Bridge Pier Scour Scour GSDs_Images\DSCF0409.JPG

- Scale Line Length: 24 in
- Median Filter Radius: 2 px
- Background Subtraction Radius: 3 px
- Advanced Controls:
    - Automate Threshold Selection
    - Threshold Value: 211
    - Morphologic Iterations: 1
    - Resolution: 27 %
    - Flood Depth: 0.9 px


Semi-log Gradation Plot
Percent Finer by particle size - %
0
10
20
30
40
50
60
70
80
90
100
Grain Size in inches
DSCF0409
DSCF0410
DSCF0411
DSCF0412
DSCF0413
DSCF0414
DSCF0415
DSCF0416
DSCF0417
DSCF0418

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.051469	0	0	0.000000
0.072788	0	0	0.000000
0.102938	0	0	0.000000
0.145576	0	0	0.000000
0.205876	3	3	0.178042
0.291152	5	8	0.474777
0.411751	15	23	1.364985
0.582304	34	57	3.382789
0.823502	89	146	8.664688
1.164608	189	335	19.881306
1.647004	277	612	36.320475
2.329216	448	1060	62.908012
3.294009	291	1351	80.178042
4.658432	151	1502	89.139466
6.588018	72	1574	93.412463
9.316864	111	1685	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.6562 in

D15: 1.0162 in

D50: 1.9980 in

D85: 4.0282 in

D100: 9.3169 in

Image Gradation Input Parameters

Name: DSCF0410

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Bridge Pier Scour Scour GSDs_Images\DSCF0410.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 202

Morphologic Iterations: 1

Resolution: 28 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.062258	0	0	0.000000
0.088046	0	0	0.000000
0.124516	0	0	0.000000
0.176092	1	1	0.058411
0.249032	4	5	0.292056
0.352184	9	14	0.817757
0.498063	26	40	2.336449
0.704368	61	101	5.899533
0.996127	128	229	13.376168
1.408736	279	508	29.672897
1.992254	378	886	51.752336
2.817472	536	1422	83.060748
3.984507	226	1648	96.261682
5.634944	64	1712	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.6523 in

D15: 1.0372 in

D50: 1.9459 in

D85: 2.9889 in

D100: 5.6349 in

Image Gradation Input Parameters

Name: DSCF0411

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Bridge Pier Scour Scour GSDs_Images\DSCF0411.JPG

- Scale Line Length: 24 in
- Median Filter Radius: 2 px
- Background Subtraction Radius: 3 px
- Advanced Controls:
  - Automate Threshold Selection
  - Threshold Value: 208
  - Morphologic Iterations: 1
  - Resolution: 27 %
  - Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.051029	0	0	0.000000
0.072166	0	0	0.000000
0.102058	0	0	0.000000
0.144332	0	0	0.000000
0.204116	2	2	0.112613
0.288664	6	8	0.450450
0.408233	16	24	1.351351
0.577328	38	62	3.490991
0.816465	90	152	8.558559
1.154656	184	336	18.918919
1.632930	320	656	36.936937
2.309312	427	1083	60.979730
3.265860	502	1585	89.245495
4.618624	146	1731	97.466216
6.531721	45	1776	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.6485 in

D15: 1.0267 in

D50: 2.0004 in

D85: 3.1222 in

D100: 6.5317 in

Image Gradation Input Parameters

Name: DSCF0412

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Bridge Pier Scour Scour GSDs_Images\DSCF0412.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 208

Morphologic Iterations: 1

Resolution: 28 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.053685	0	0	0.000000
0.075922	0	0	0.000000
0.107370	0	0	0.000000
0.151844	0	0	0.000000
0.214740	2	2	0.114155
0.303688	5	7	0.399543
0.429480	13	20	1.141553
0.607376	35	55	3.139269
0.858959	79	134	7.648402
1.214752	177	311	17.751142
1.717919	325	636	36.301370
2.429504	502	1138	64.954338
3.435838	386	1524	86.986301
4.859008	228	1752	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.7112 in

D15: 1.1179 in

D50: 2.0581 in

D85: 3.3451 in

D100: 4.8590 in

Image Gradation Input Parameters

Name: DSCF0413

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Bridge Pier Scour Scour GSDs_Images\DSCF0413.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 212

Morphologic Iterations: 1

Resolution: 28 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.054003	0	0	0.000000
0.076372	0	0	0.000000
0.108006	0	0	0.000000
0.152744	1	1	0.050403
0.216013	3	4	0.201613
0.305488	8	12	0.604839
0.432025	22	34	1.713710
0.610976	55	89	4.485887
0.864051	128	217	10.937500
1.221952	262	479	24.143145
1.728101	401	880	44.354839
2.443904	520	1400	70.564516
3.456202	439	1839	92.691532
4.887808	145	1984	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.6311 in

D15: 0.9742 in

D50: 1.8823 in

D85: 3.1043 in

D100: 4.8878 in

Image Gradation Input Parameters

Name: DSCF0414

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Bridge Pier Scour Scour GSDs_Images\DSCF0414.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 203

Morphologic Iterations: 1

Resolution: 29 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.069212	0	0	0.000000
0.097880	0	0	0.000000
0.138423	0	0	0.000000
0.195760	1	1	0.058789
0.276846	4	5	0.293945
0.391520	11	16	0.940623
0.553693	23	39	2.292769
0.783040	52	91	5.349794
1.107386	140	231	13.580247
1.566080	244	475	27.924750
2.214772	355	830	48.794827
3.132160	406	1236	72.663139
4.429543	389	1625	95.532040
6.264320	0	1625	95.532040
8.859086	76	1701	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.7568 in

D15: 1.1528 in

D50: 2.2611 in

D85: 3.8320 in

D100: 8.8591 in

Image Gradation Input Parameters

Name: DSCF0415

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Bridge Pier Scour Scour GSDs_Images\DSCF0415.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 208

Morphologic Iterations: 1

Resolution: 28 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.045690	0	0	0.000000
0.064616	0	0	0.000000
0.091381	0	0	0.000000
0.129232	0	0	0.000000
0.182762	1	1	0.058140
0.258464	3	4	0.232558
0.365523	10	14	0.813953
0.516928	25	39	2.267442
0.731047	71	110	6.395349
1.033856	119	229	13.313953
1.462093	242	471	27.383721
2.067712	368	839	48.779070
2.924186	347	1186	68.953488
4.135424	275	1461	84.941860
5.848373	186	1647	95.755814
8.270848	73	1720	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.6587 in

D15: 1.0852 in

D50: 2.1195 in

D85: 4.1446 in

D100: 8.2708 in

Image Gradation Input Parameters

Name: DSCF0416

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Bridge Pier Scour Scour GSDs_Images\DSCF0416.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 205

Morphologic Iterations: 1

Resolution: 28 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.070923	0	0	0.000000
0.100300	0	0	0.000000
0.141846	0	0	0.000000
0.200600	2	2	0.110865
0.283691	6	8	0.443459
0.401200	14	22	1.219512
0.567382	34	56	3.104213
0.802400	83	139	7.705100
1.134765	165	304	16.851441
1.604800	344	648	35.920177
2.269530	438	1086	60.199557
3.209600	387	1473	81.651885
4.539060	290	1763	97.727273
6.419200	41	1804	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.6642 in

D15: 1.0675 in

D50: 1.9903 in

D85: 3.4865 in

D100: 6.4192 in

Image Gradation Input Parameters

Name: DSCF0417

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Bridge Pier Scour Scour GSDs_Images\DSCF0417.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 204

Morphologic Iterations: 1

Resolution: 28 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.055775	0	0	0.000000
0.078878	0	0	0.000000
0.111550	0	0	0.000000
0.157756	0	0	0.000000
0.223101	3	3	0.184162
0.315512	5	8	0.491099
0.446201	15	23	1.411909
0.631024	39	62	3.806016
0.892403	78	140	8.594230
1.262048	168	308	18.907305
1.784805	362	670	41.129527
2.524096	535	1205	73.971762
3.569611	302	1507	92.510743
5.048192	122	1629	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.6962 in

D15: 1.1220 in

D50: 1.9845 in

D85: 3.1460 in

D100: 5.0482 in

Image Gradation Input Parameters

Name: DSCF0418

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Bridge Pier Scour Scour GSDs_Images\DSCF0418.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 207

Morphologic Iterations: 1

Resolution: 29 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.050496	0	0	0.000000
0.071412	0	0	0.000000
0.100992	0	0	0.000000
0.142824	1	1	0.054259
0.201984	2	3	0.162778
0.285648	7	10	0.542594
0.403967	18	28	1.519262
0.571296	42	70	3.798155
0.807935	96	166	9.007054
1.142592	224	390	21.161150
1.615869	365	755	40.965817
2.285184	441	1196	64.894194
3.231738	399	1595	86.543679
4.570368	197	1792	97.232773
6.463476	51	1843	100.000000

Two sediment samples were collected from the channel bed near Bridge E-10-A. Results of the sediment size analysis for the sediment sample collected from the channel are presented below in both tabular and graphical formats.

Figure G.2.1.
Photo of sediment sample from the E-10-A site

Table G.2.1.
Sediment sieve analysis
Sample ID: E-10-A Up RR, Colorado River
Sample Description: 1 of 2
Performed by: JE
Date: 9-20-2011

Sieve Size (mm)	% Finer
60	100%
44.45	100%
25.4	87%
19.1	78%
4	34%
2	28%
1	23%
0.5	22%
0.25	13%

Figure G.2.2.

Grain size gradation curve for the sediment sample collected from the Colorado River in the vicinity of E-10-A

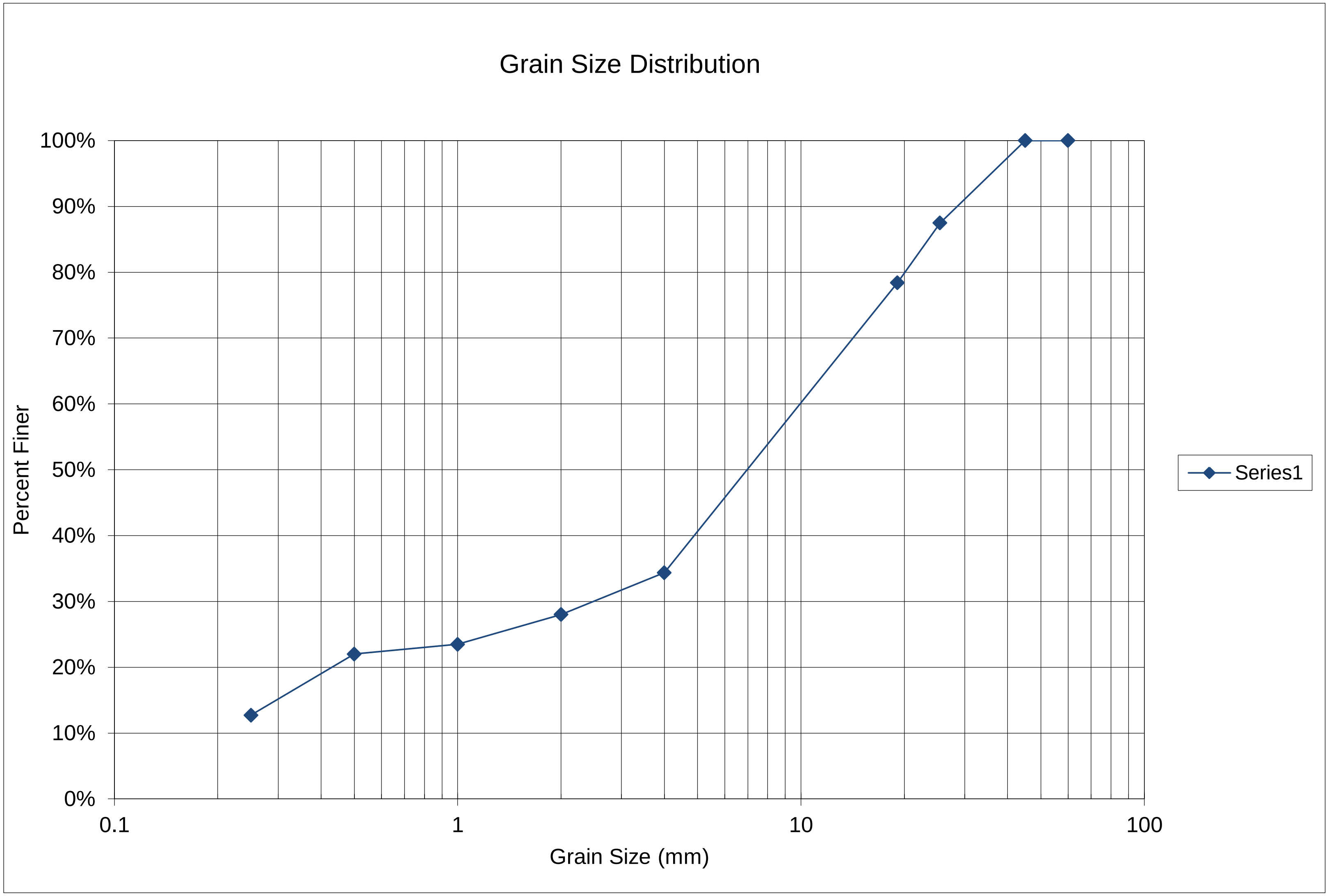


Table G.2.2.

Grain size gradation computations for the sediment sample collected from the Colorado River in the vicinity of E-10-A

Structure # E-10-A	**Waterbody - Upper Colorado River**	**Sample # 1 of 2**	Performed by: JE			
			Date: 9/20/2011			
Sieve Size (mm)	Weight of Sieve (g)	Weight of Sieve + Soil (g)	Weight of Soil (g)	% Retained	Cumulative % Ret.	% Finer
60	0	0	0	0%	0%	100%
45	0	0	0	0%	0%	100%
25.4	692.82	1029.1	336.28	13%	13%	87%
19.1	610.29	854.01	243.72	9%	22%	78%
4	507.9	1692.4	1184.5	44%	66%	34%
2	476.34	646.98	170.64	6%	72%	28%
1	452.76	574.39	121.63	5%	77%	23%
0.5	456.43	496.53	40.1	1%	78%	22%
0.25	395.56	644.93	249.37	9%	87%	13%
Pan	368.74	710.86	342.12	13%	100%	0%
		Total Weight of Sample	**2688.36**			

Figure G.2.3.

Photo of sediment sample from the E-10-A site

Table G.2.3.

Sediment sieve analysis
Sample ID: E-10-A Up RR, Colorado River
Sample Description: 2 of 2
Performed by: JE
Date: 9-20-2011

Sieve Size (mm)	% Finer
60	100%
44.45	100%
32	76%
16	46%
4	20%
2	15%
1	13%
0.5	11%
0.25	5%

Figure G.2.4.

Grain size gradation curve for the sediment sample collected from the Colorado River in the vicinity of E-10-A

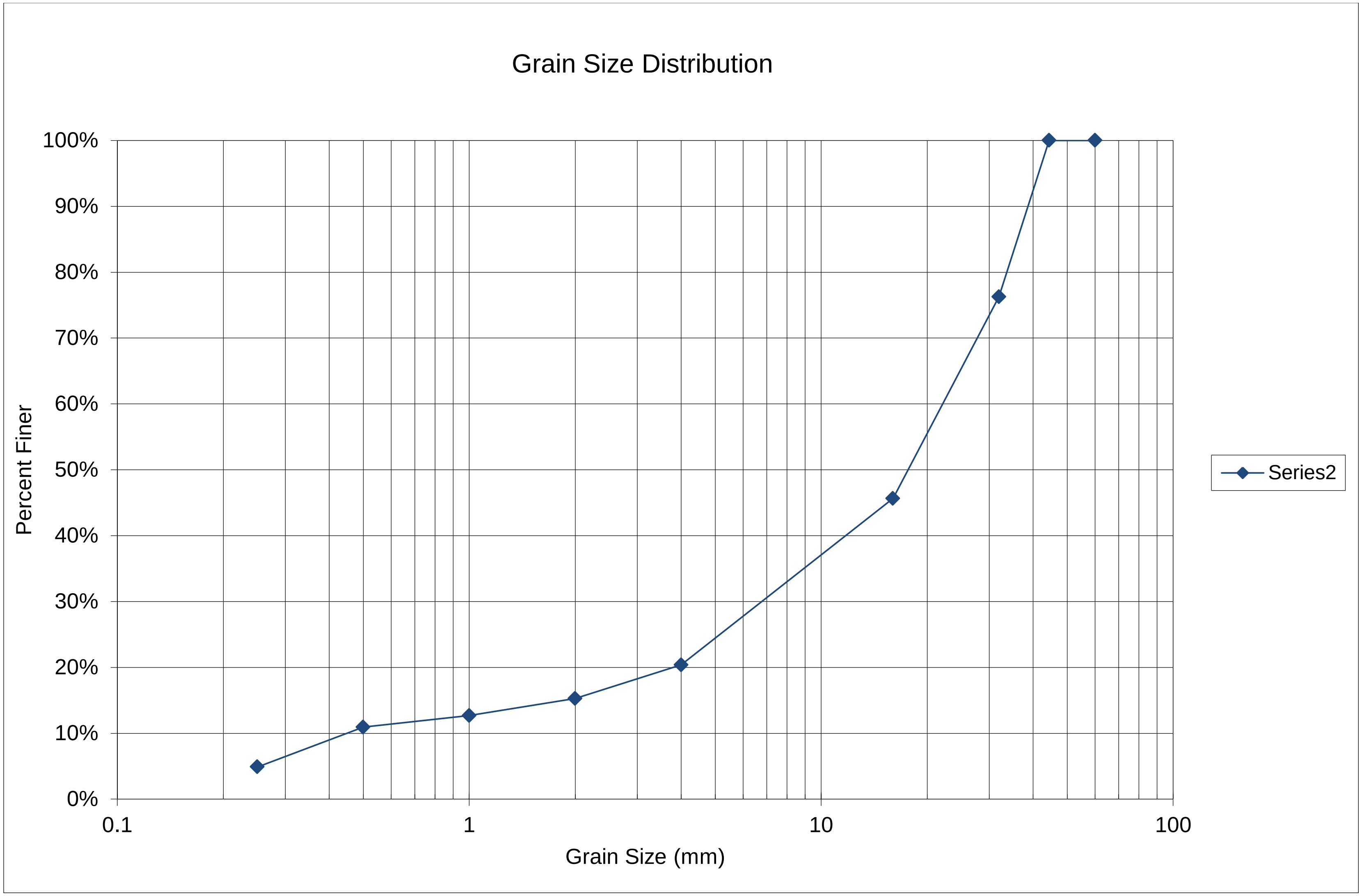


Table G.2.4.

Grain size gradation computations for the sediment sample collected from the Colorado River in the vicinity of E-10-A

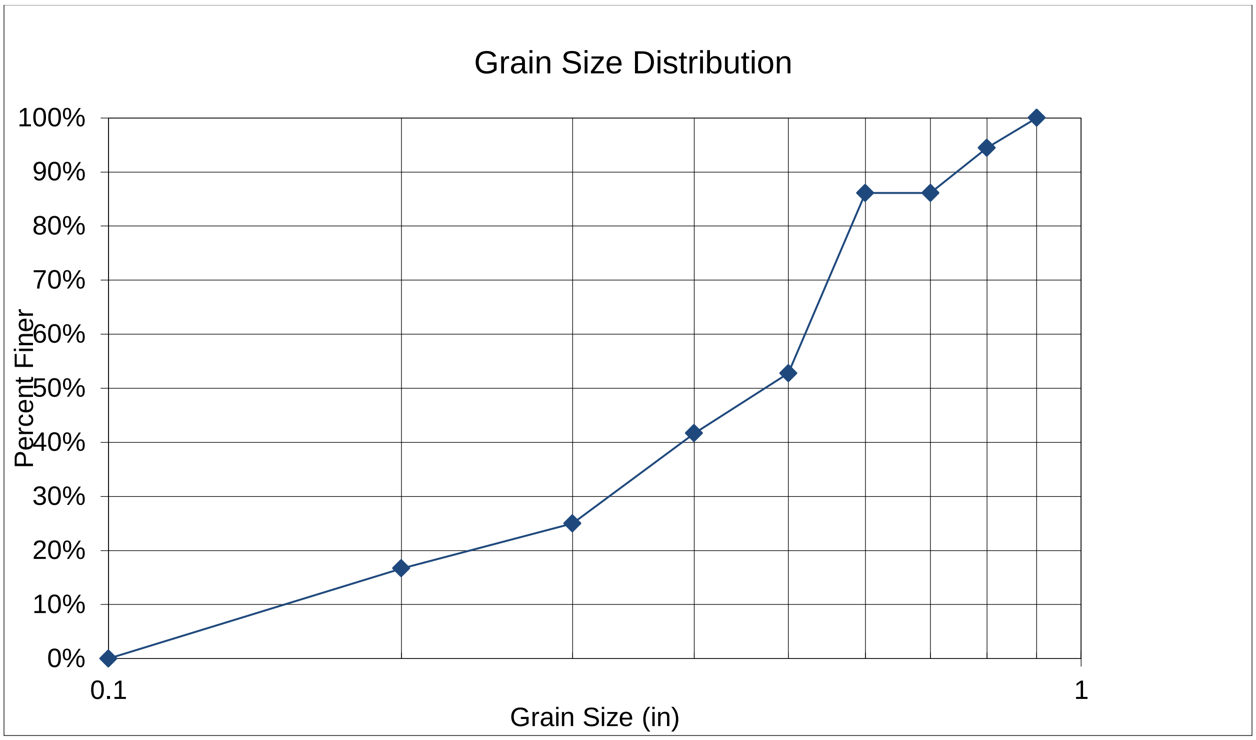
Structure # E-10-A	**Waterbody - Upper Colorado River**	**Sample # 2 of 2**	Performed by: JE Date: 9/20/2011			
Sieve Size (mm)	Weight of Sieve (g)	Weight of Sieve + Soil (g)	Weight of Soil (g)	% Retained	Cumulative % Ret.	% Finer
60	0	0	0	0%	0%	100%
44.45	0	0	0	0%	0%	100%
32	549.32	1281.9	732.58	24%	24%	76%
16	558.8	1503.6	944.8	31%	54%	46%
4	507.92	1287.9	779.98	25%	80%	20%
2	476.34	633.57	157.23	5%	85%	15%
1	452.76	532.96	80.2	3%	87%	13%
0.5	456.43	510.86	54.43	2%	89%	11%
0.25	402.38	588.49	186.11	6%	95%	5%
Pan	368.73	519.61	150.88	5%	100%	0%
		Total Weight of Sample	**3086.21**			

Pebble Count Grain Size Distribution

Region	Structure ID	County	Facility Carried	Mile Marker	POA Fiscal Year	Feature Intersected	D_{50} min from POA	D_{50} max from POA
3	E-10-A	Eagle	SH 131 ML	13.6	2012	Colorado River	7	17

Sample #	A (ft)	B (ft)	C (ft)	Shape Factor	D_s (ft)	D_{avg} (ft)	Volume (ft³)
1	0.93	0.58	0.32	0.436	0.58	0.610	0.090
2	0.56	0.48	0.2	0.386	0.48	0.413	0.028
3	1.34	0.78	0.46	0.450	0.78	0.860	0.252
4	0.74	0.57	0.23	0.354	0.57	0.513	0.051
5	0.82	0.46	0.31	0.505	0.46	0.530	0.061
6	0.97	0.72	0.26	0.311	0.72	0.650	0.095
7	1.02	0.57	0.44	0.577	0.57	0.677	0.134
8	0.79	0.53	0.37	0.572	0.53	0.563	0.081
9	0.31	0.18	0.06	0.254	0.18	0.183	0.002
10	0.32	0.19	0.08	0.324	0.19	0.197	0.003
11	0.15	0.11	0.07	0.545	0.11	0.110	0.001
12	0.54	0.15	0.07	0.246	0.15	0.253	0.003
13	0.57	0.16	0.07	0.232	0.16	0.267	0.003
14	0.81	0.28	0.08	0.168	0.28	0.390	0.010
15	0.85	0.47	0.06	0.095	0.47	0.460	0.013
16	0.33	0.31	0.06	0.188	0.31	0.233	0.003
17	0.52	0.29	0.17	0.438	0.29	0.327	0.013
18	1.62	0.83	0.16	0.138	0.83	0.870	0.113
19	0.78	0.57	0.38	0.570	0.57	0.577	0.088
20	0.63	0.51	0.06	0.106	0.51	0.400	0.010
21	0.64	0.53	0.24	0.412	0.53	0.470	0.043
22	0.53	0.31	0.22	0.543	0.31	0.353	0.019
23	1.22	0.84	0.48	0.474	0.84	0.847	0.258
24	1.1	0.54	0.32	0.415	0.54	0.653	0.100
25	0.53	0.33	0.19	0.454	0.33	0.350	0.017
26	0.47	0.39	0.19	0.444	0.39	0.350	0.018
27	1.25	0.58	0.27	0.317	0.58	0.700	0.102
28	0.79	0.59	0.12	0.176	0.59	0.500	0.029
29	0.47	0.33	0.22	0.559	0.33	0.340	0.018
30	1.13	0.58	0.29	0.358	0.58	0.667	0.100
31	0.62	0.37	0.26	0.543	0.37	0.417	0.031
32	0.48	0.19	0.16	0.530	0.19	0.277	0.008
33	0.66	0.51	0.09	0.155	0.51	0.420	0.016
34	0.76	0.47	0.08	0.134	0.47	0.437	0.015
35	0.36	0.27	0.08	0.257	0.27	0.237	0.004
36	1.24	0.78	0.56	0.569	0.78	0.860	0.284

Structure # E-10-A	Colorado River at SH 131			
Sieve Size (ft)	Samples Retained	% Retained	Cumulative % Ret.	% Finer
0.9	0	0%	0%	100%
0.8	2	6%	6%	94%
0.7	3	8%	14%	86%
0.6	0	0%	14%	86%
0.5	12	33%	47%	53%
0.4	4	11%	58%	42%
0.3	6	17%	75%	25%
0.2	3	8%	83%	17%
0.1	6	17%	100%	0%
Total Samples	36			



Hydraulic Analysis Report

Project Data

Project Title: E-10-A

Designer:

Project Date: Friday, September 13, 2013

Project Units: U.S. Customary Units

Notes:

Wolman Count Analysis: Gradation Analysis

Notes:

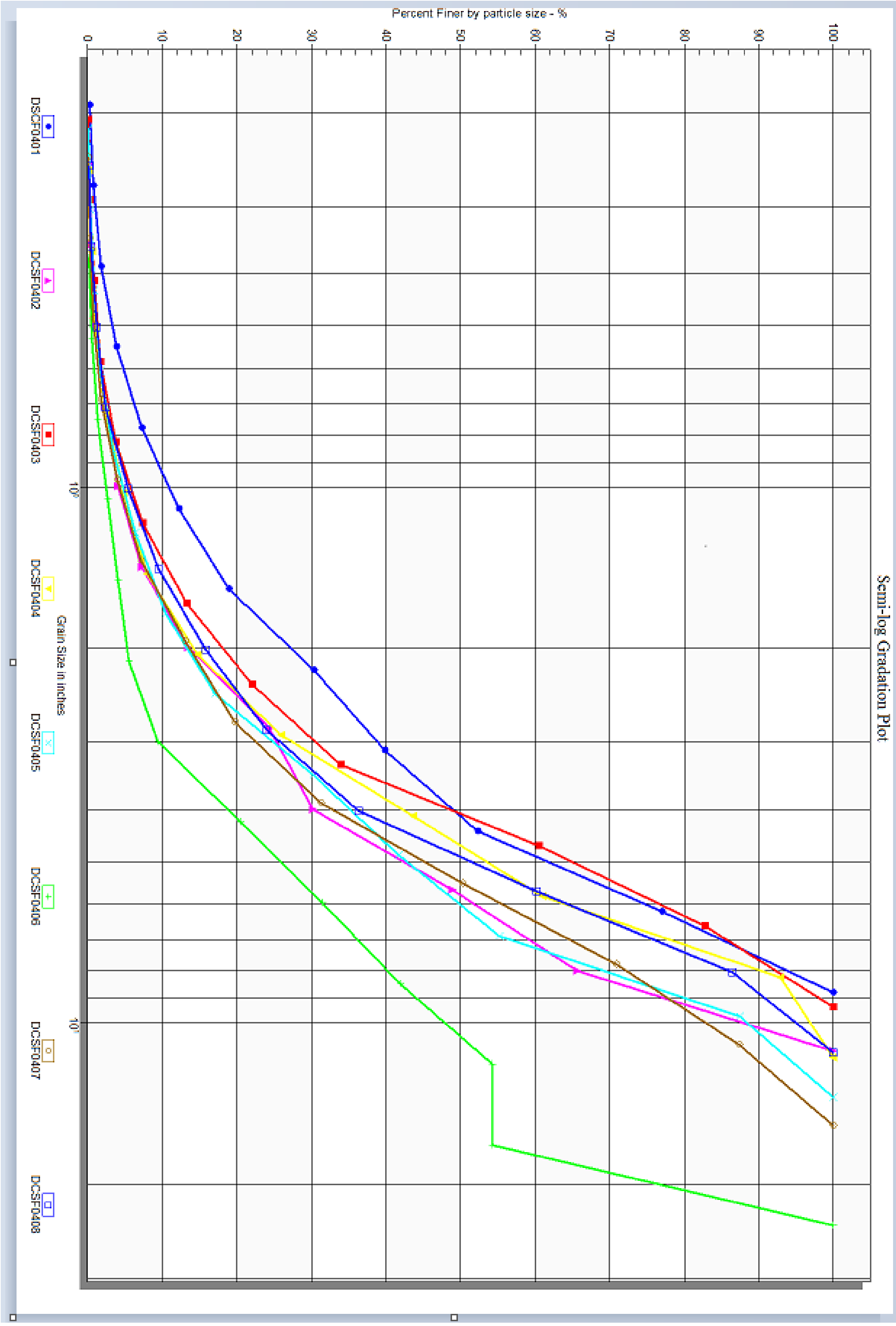

Semi-log Gradation Plot
Percent Finer by particle size - %
0
10
20
30
40
50
60
70
80
90
100
Grain Size in inches
10^0
10^1
DSCF0401
DSCF0402
DSCF0403
DSCF0404
DSCF0405
DSCF0406
DSCF0407
DSCF0408

Image Gradation Input Parameters

Name: DSCF0401

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox Work_Images\DSCF0401.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 184

Morphologic Iterations: 1

Resolution: 29 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.048457	0	0	0.000000
0.068529	0	0	0.000000
0.096914	0	0	0.000000
0.137057	0	0	0.000000
0.193828	4	4	0.277971
0.274115	7	11	0.764420
0.387657	15	26	1.806810
0.548229	29	55	3.822099
0.775313	50	105	7.296734
1.096459	71	176	12.230716
1.550627	96	272	18.902015
2.192917	164	436	30.298819
3.101253	138	574	39.888812
4.385835	179	753	52.328006
6.202507	356	1109	77.067408
8.771669	330	1439	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.6252 in

D15: 1.2850 in

D50: 4.1454 in

D85: 7.0912 in

D100: 8.7717 in

Image Gradation Input Parameters

Name: DCSF0402

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox Work_Images\DSCF0402.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 187

Morphologic Iterations: 1

Resolution: 29 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.062417	0	0	0.000000
0.088271	0	0	0.000000
0.124834	0	0	0.000000
0.176542	0	0	0.000000
0.249667	1	1	0.107296
0.353083	3	4	0.429185
0.499335	6	10	1.072961
0.706166	11	21	2.253219
0.998670	17	38	4.077253
1.412332	30	68	7.296137
1.997340	58	126	13.519313
2.824665	101	227	24.356223
3.994679	55	282	30.257511
5.649330	174	456	48.927039
7.989359	156	612	65.665236
11.298660	320	932	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.1173 in

D15: 2.1104 in

D50: 5.7993 in

D85: 9.8529 in

D100: 11.2987 in

Image Gradation Input Parameters

Name: DCSF0403

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox Work_Images\DSCF0403.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 180

Morphologic Iterations: 1

Resolution: 27 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.051568	0	0	0.000000
0.072928	0	0	0.000000
0.103135	0	0	0.000000
0.145856	0	0	0.000000
0.206271	1	1	0.096339
0.291711	2	3	0.289017
0.412542	6	9	0.867052
0.583422	9	18	1.734104
0.825084	21	39	3.757225
1.166845	37	76	7.321773
1.650168	62	138	13.294798
2.333690	91	229	22.061657
3.300335	123	352	33.911368
4.667379	276	628	60.500963
6.600671	231	859	82.755299
9.334758	179	1038	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.9442 in

D15: 1.7831 in

D50: 4.1275 in

D85: 6.9566 in

D100: 9.3348 in

Image Gradation Input Parameters

Name: DCSF0404

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox Work_Images\DSCF0404.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 184

Morphologic Iterations: 1

Resolution: 27 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.064191	0	0	0.000000
0.090779	0	0	0.000000
0.128381	0	0	0.000000
0.181559	0	0	0.000000
0.256763	2	2	0.171527
0.363118	4	6	0.514580
0.513526	6	12	1.029160
0.726235	16	28	2.401372
1.027052	28	56	4.802744
1.452471	37	93	7.975986
2.054104	79	172	14.751286
2.904941	130	302	25.900515
4.108207	207	509	43.653516
5.809883	202	711	60.977702
8.216415	372	1083	92.881647
11.619765	83	1166	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.0535 in

D15: 2.0731 in

D50: 4.7316 in

D85: 7.6219 in

D100: 11.6198 in

Image Gradation Input Parameters

Name: DCSF0405

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox Work_Images\DSCF0405.JPG

- Scale Line Length: 24 in
- Median Filter Radius: 2 px
- Background Subtraction Radius: 3 px
- Advanced Controls:
  - Automate Threshold Selection
  - Threshold Value: 183
  - Morphologic Iterations: 1
  - Resolution: 27 %
  - Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.053776	0	0	0.000000
0.076051	0	0	0.000000
0.107553	0	0	0.000000
0.152102	0	0	0.000000
0.215105	1	1	0.092166
0.304205	3	4	0.368664
0.430210	5	9	0.829493
0.608409	10	19	1.751152
0.860421	18	37	3.410138
1.216818	32	69	6.359447
1.720841	45	114	10.506912
2.433637	71	185	17.050691
3.441682	143	328	30.230415
4.867274	124	452	41.658986
6.883365	147	599	55.207373
9.734547	350	949	87.465438
13.766729	136	1085	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.0525 in

D15: 2.2103 in

D50: 6.1085 in

D85: 9.5166 in

D100: 13.7667 in

Image Gradation Input Parameters

Name: DCSF0406

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox Work_Images\DSCF0406.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 186

Morphologic Iterations: 1

Resolution: 27 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.066003	0	0	0.000000
0.093342	0	0	0.000000
0.132006	0	0	0.000000
0.186685	0	0	0.000000
0.264012	0	0	0.000000
0.373370	1	1	0.167504
0.528024	2	3	0.502513
0.746739	5	8	1.340034
1.056049	8	16	2.680067
1.493479	8	24	4.020101
2.112098	9	33	5.527638
2.986957	23	56	9.380235
4.224195	66	122	20.435511
5.973914	66	188	31.490787
8.448390	62	250	41.876047
11.947828	74	324	54.271357
16.896781	0	324	54.271357
23.895657	273	597	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.8956 in

D15: 3.6159 in

D50: 10.7419 in

D85: 21.5999 in

D100: 23.8957 in

Image Gradation Input Parameters

Name: DCSF0407

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox Work_Images\DSCF0407.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 156

Morphologic Iterations: 1

Resolution: 28 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.085835	0	0	0.000000
0.121389	0	0	0.000000
0.171670	0	0	0.000000
0.242778	1	1	0.091324
0.343340	2	3	0.273973
0.485556	5	8	0.730594
0.686680	12	20	1.826484
0.971112	23	43	3.926941
1.373359	35	78	7.123288
1.942224	65	143	13.059361
2.746719	73	216	19.726027
3.884447	127	343	31.324201
5.493438	207	550	50.228311
7.768894	226	776	70.867580
10.986875	180	956	87.305936
15.537788	139	1095	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.1062 in

D15: 2.1764 in

D50: 5.4740 in

D85: 10.5355 in

D100: 15.5378 in

Image Gradation Input Parameters

Name: DCSF0408

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox Work_Images\DSCF0408.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 166

Morphologic Iterations: 1

Resolution: 28 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.062859	0	0	0.000000
0.088896	0	0	0.000000
0.125718	0	0	0.000000
0.177792	0	0	0.000000
0.251436	2	2	0.166945
0.355584	3	5	0.417362
0.502872	9	14	1.168614
0.711168	15	29	2.420701
1.005744	36	65	5.425710
1.422337	49	114	9.515860
2.011488	75	189	15.776294
2.844673	98	287	23.956594
4.022975	148	435	36.310518
5.689346	286	721	60.183639
8.045950	315	1036	86.477462
11.378692	162	1198	100.000000

Two sediment samples were collected from the channel bed near Bridge F-06-M. Results of the sediment size analysis for the sediment sample collected from the channel are presented below in both tabular and graphical formats.

Figure G.3.1.
Photo of sediment sample from the F-06-M site

Table G.3.1.
Sediment sieve analysis
Sample ID: F-06-M Colorado River
Sample Description: 1 of 2
Performed by: JE
Date: 10-10-2011

Sieve Size (mm)	% Finer
44.45	100%
16	64%
4	43%
2	38%
1.4	34%
1	29%
0.5	18%
0.25	3%

Figure G.3.2.

Grain size gradation curve for the sediment sample collected from the Colorado River in the vicinity of F-06-M

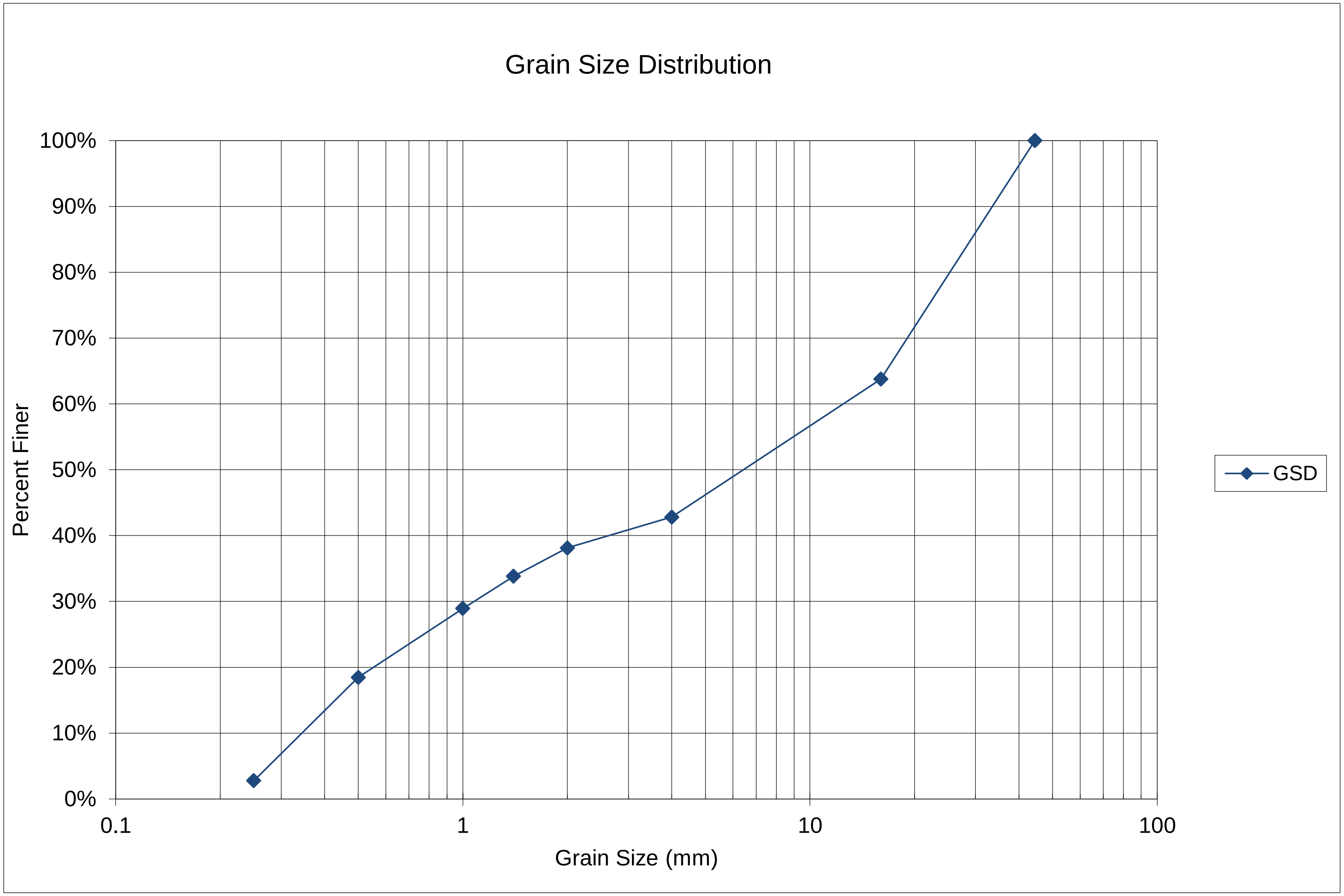


Table G.3.2.

Grain size gradation computations for the sediment sample collected from the Colorado River in the vicinity of F-06-M

Structure # F-06-M	**Waterbody - Colorado River**	**Sample # 1 of 2**	Performed by: JE Date: 10/10/2011			
Sieve Size (mm)	Weight of Sieve (g)	Weight of Sieve + Soil (g)	Weight of Soil (g)	% Retained	Cumulative % Ret.	% Finer
44.45	0	0	0	0%	0%	100%
16	542.97	1930.8	1387.83	36%	36%	64%
4	519.95	1322.5	802.55	21%	57%	43%
2	468.4	647.45	179.05	5%	62%	38%
1.4	454.95	620.14	165.19	4%	66%	34%
1	502.38	689.81	187.43	5%	71%	29%
0.5	440.34	841.43	401.09	10%	82%	18%
0.25	398.61	999.02	600.41	16%	97%	3%
Pan	356.25	462.72	106.47	3%	100%	0%
		Total Weight of Sample	**3830.02**			

Figure G.3.3.
Photo of sediment sample from the F-06-M site

Table G.3.3.
Sediment sieve analysis
Sample ID: F-06-M Colorado River
Sample Description: 2 of 2
Performed by: JE
Date: 9-20-2011

Sieve Size (mm)	% Finer
44.45	100%
16	35%
4	27%
2	24%
1.4	22%
1	20%
0.5	14%
0.25	7%

Figure G.3.4.

Grain size gradation curve for the sediment sample collected from the Colorado River in the vicinity of F-06-M

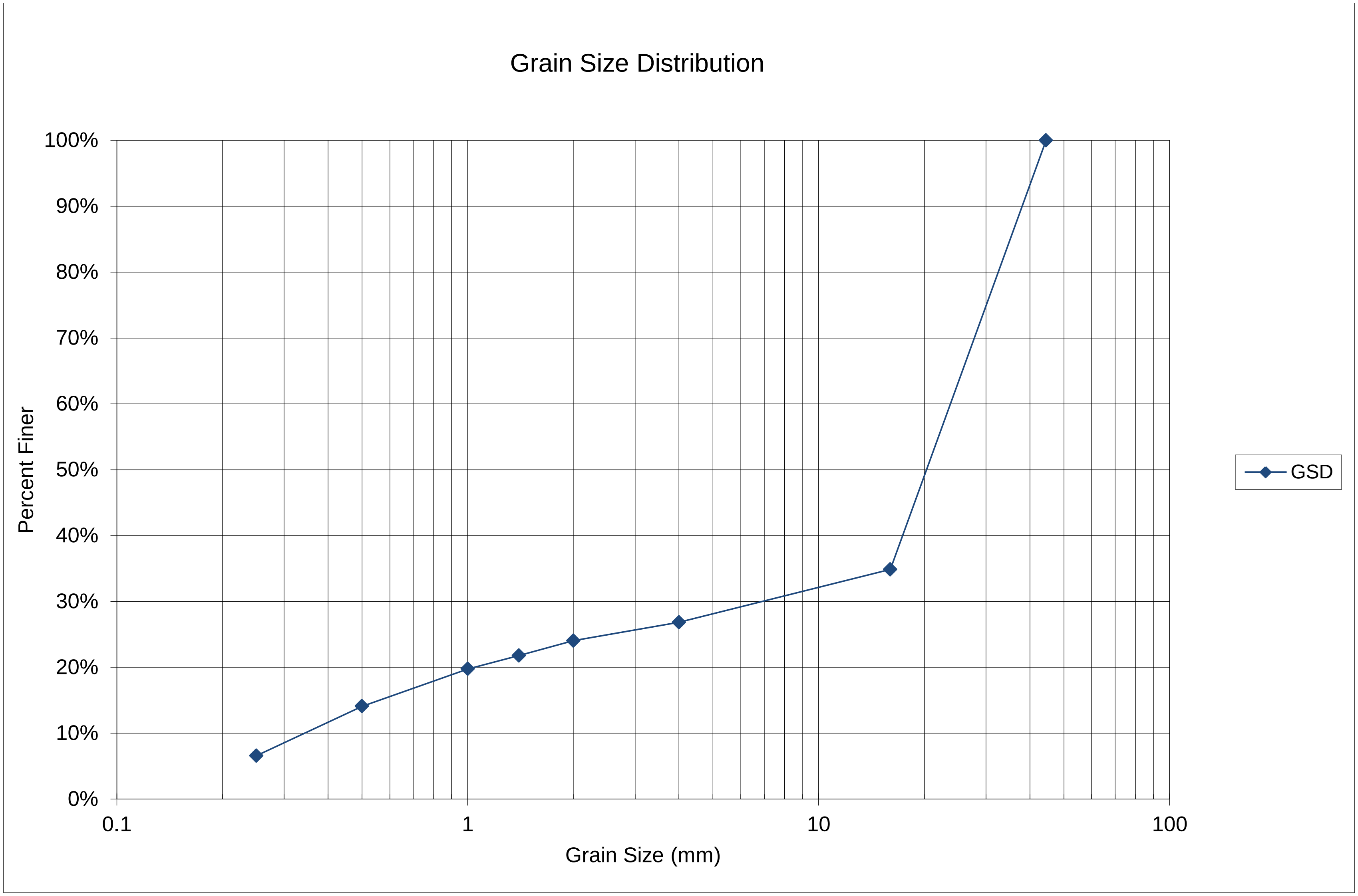


Table G.3.4.

Grain size gradation computations for the sediment sample collected from the Colorado River in the vicinity of F-06-M

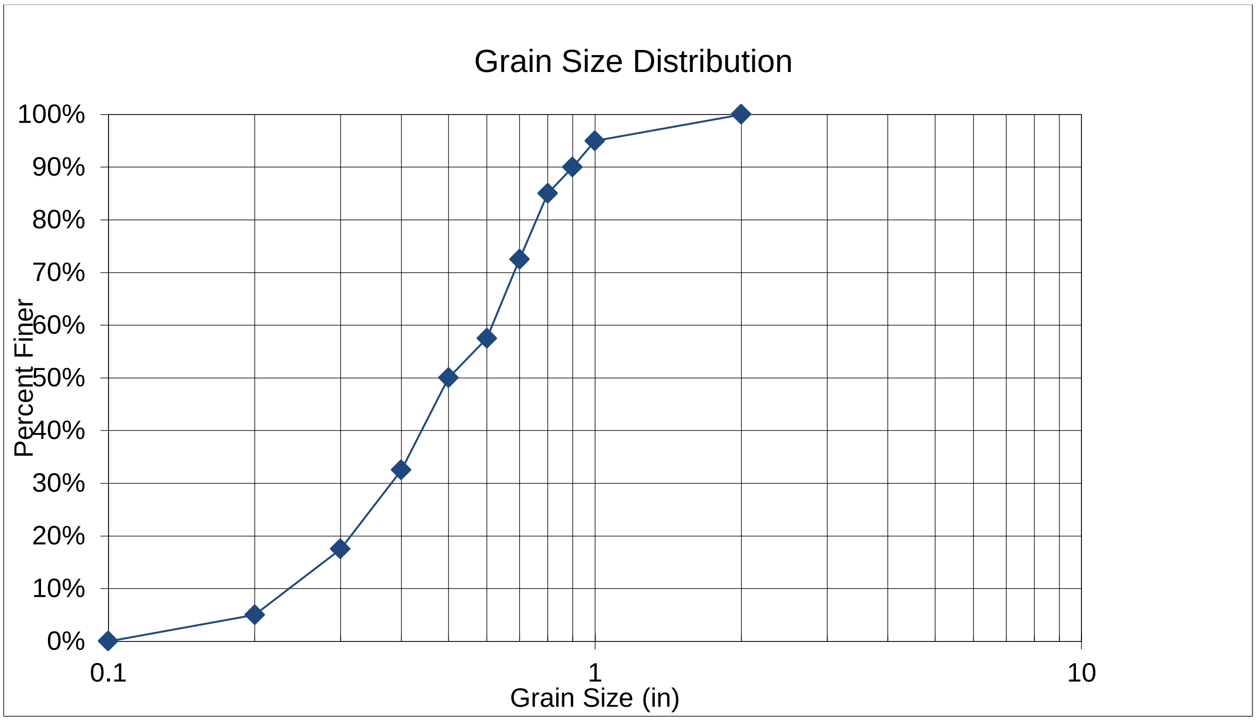
Structure # F-06-M	**Waterbody - Colorado River**	**Sample # 2 of 2**	Performed by: JE Date: 10/10/2011			
Sieve Size (mm)	Weight of Sieve (g)	Weight of Sieve + Soil (g)	Weight of Soil (g)	% Retained	Cumulative % Ret.	% Finer
44.45	0	0	0	0%	0%	100%
16	542.97	2612	2069.03	65%	65%	35%
4	510.34	765.56	255.22	8%	73%	27%
2	468.4	556.81	88.41	3%	76%	24%
1.4	442.21	513.91	71.7	2%	78%	22%
1	500.21	564.97	64.76	2%	80%	20%
0.5	440.34	620.23	179.89	6%	86%	14%
0.25	397.44	635.56	238.12	7%	93%	7%
Pan	355.2	564.5	209.3	7%	100%	0%
		Total Weight of Sample	**3176.43**			

Pebble Count Grain Size Distribution

Region	Structure ID	County	Facility Carried	Mile Marker	POA Fiscal Year	Feature Intersected	D_{50} min from POA	D_{50} max from POA	Date
3	F-06-M	Garfield	I 70 Access Road	105.3	2012	Colorado River	6.5	20	8/9/2013

Sample #	A (ft)	B (ft)	C (ft)	Shape Factor	D_s (ft)	D_{avg} (ft)	Volume (ft³)
1	0.59	0.42	0.29	0.583	0.42	0.433	0.038
2	0.51	0.26	0.1	0.275	0.26	0.290	0.007
3	0.83	0.55	0.18	0.266	0.55	0.520	0.043
4	1.3	1.05	0.37	0.317	1.05	0.907	0.264
5	0.36	0.28	0.22	0.693	0.28	0.287	0.012
6	0.51	0.32	0.26	0.644	0.32	0.363	0.022
7	1.02	0.73	0.19	0.220	0.73	0.647	0.074
8	0.35	0.35	0.22	0.629	0.35	0.307	0.014
9	0.96	0.8	0.54	0.616	0.8	0.767	0.217
10	0.72	0.59	0.43	0.660	0.59	0.580	0.096
11	0.26	0.19	0.14	0.630	0.19	0.197	0.004
12	0.54	0.47	0.28	0.556	0.47	0.430	0.037
13	0.46	0.31	0.18	0.477	0.31	0.317	0.013
14	0.87	0.42	0.3	0.496	0.42	0.530	0.057
15	0.59	0.57	0.35	0.604	0.57	0.503	0.062
16	0.48	0.36	0.14	0.337	0.36	0.327	0.013
17	0.86	0.64	0.32	0.431	0.64	0.607	0.092
18	0.56	0.45	0.19	0.378	0.45	0.400	0.025
19	0.84	0.49	0.4	0.623	0.49	0.577	0.086
20	0.89	0.65	0.45	0.592	0.65	0.663	0.136
21	0.47	0.35	0.27	0.666	0.35	0.363	0.023
22	0.93	0.74	0.3	0.362	0.74	0.657	0.108
23	0.89	0.7	0.3	0.380	0.7	0.630	0.098
24	0.31	0.26	0.2	0.704	0.26	0.257	0.008
25	2.42	1.91	1.56	0.726	1.91	1.963	3.775
26	0.83	0.72	0.36	0.466	0.72	0.637	0.113
27	0.41	0.3	0.18	0.513	0.3	0.297	0.012
28	0.62	0.49	0.27	0.490	0.49	0.460	0.043
29	0.83	0.62	0.47	0.655	0.62	0.640	0.127
30	0.92	0.68	0.29	0.367	0.68	0.630	0.095
31	1.1	0.92	0.67	0.666	0.92	0.897	0.355
32	0.96	0.64	0.45	0.574	0.64	0.683	0.145
33	0.26	0.22	0.05	0.209	0.22	0.177	0.001
34	1.05	0.87	0.3	0.314	0.87	0.740	0.143
35	0.17	0.13	0.09	0.605	0.13	0.130	0.001
36	1.43	0.75	0.7	0.676	0.75	0.960	0.393
37	0.42	0.41	0.36	0.868	0.41	0.397	0.032
38	0.73	0.66	0.22	0.317	0.66	0.537	0.055
39	0.36	0.23	0.1	0.348	0.23	0.230	0.004
40	1.4	0.96	0.43	0.371	0.96	0.930	0.303

Structure # F-06-M	Colorado River at I 70 Access Road			
Sieve Size (ft)	Samples Retained	% Retained	Cumulative % Ret.	% Finer
2	0	0%	0%	100%
1	2	5%	5%	95%
0.9	2	5%	10%	90%
0.8	2	5%	15%	85%
0.7	5	13%	28%	73%
0.6	6	15%	43%	58%
0.5	3	8%	50%	50%
0.4	7	18%	68%	33%
0.3	6	15%	83%	18%
0.2	5	13%	95%	5%
0.1	2	5%	100%	0%
Total Samples	40			



Hydraulic Analysis Report

Project Data

Project Title: F-06-M

Designer:

Project Date: Wednesday, September 18, 2013

Project Units: U.S. Customary Units

Notes:

Wolman Count Analysis: Rock/Sediment Gradation Analysis

Notes:

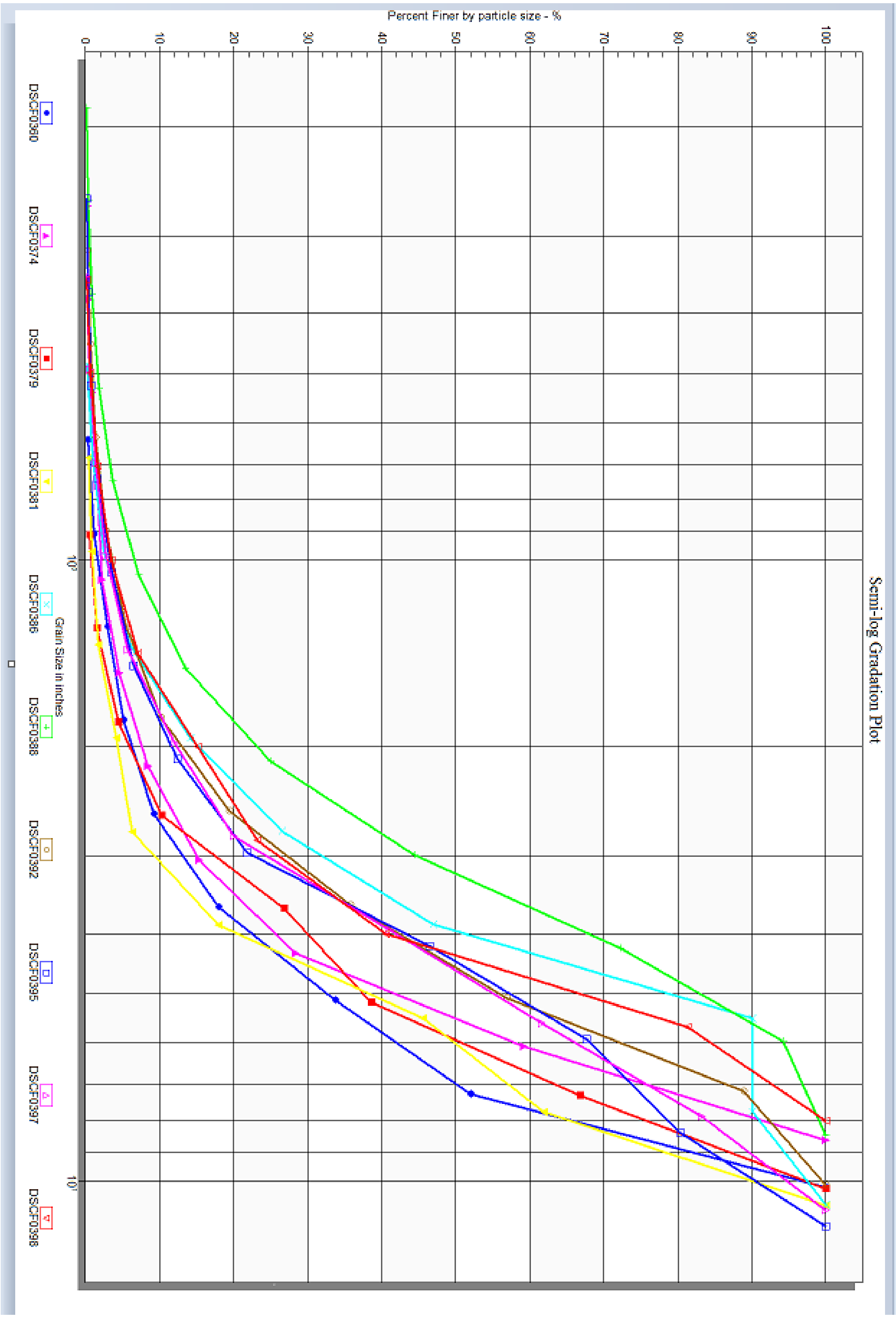

Semi-log Gradation Plot
Percent Finer by particle size - %
0
10
20
30
40
50
60
70
80
90
100
Grain Size in inches
DSCF0360
DSCF0374
DSCF0379
DSCF0381
DSCF0386
DSCF0388
DSCF0392
DSCF0395
DSCF0397
DSCF0398

Image Gradation Input Parameters

Name: DSCF0360

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0360.JPG

- Scale Line Length: 24 in
- Median Filter Radius: 2 px
- Background Subtraction Radius: 3 px
- Advanced Controls:
  - Automate Threshold Selection
  - Threshold Value: 170
  - Morphologic Iterations: 1
  - Resolution: 34 %
  - Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.056605	0	0	0.000000
0.080052	0	0	0.000000
0.113211	0	0	0.000000
0.160104	0	0	0.000000
0.226421	0	0	0.000000
0.320208	0	0	0.000000
0.452842	0	0	0.000000
0.640416	1	1	0.366300
0.905685	2	3	1.098901
1.280832	5	8	2.930403
1.811370	6	14	5.128205
2.561664	11	25	9.157509
3.622740	24	49	17.948718
5.123328	43	92	33.699634
7.245480	50	142	52.014652
10.246656	131	273	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.7804 in

D15: 3.2668 in

D50: 7.0120 in

D85: 9.3085 in

D100: 10.2467 in

Image Gradation Input Parameters

Name: DSCF0374

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0374.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 173

Morphologic Iterations: 1

Resolution: 32 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.033602	0	0	0.000000
0.047520	0	0	0.000000
0.067203	0	0	0.000000
0.095040	0	0	0.000000
0.134407	0	0	0.000000
0.190080	0	0	0.000000
0.268814	1	1	0.196850
0.380160	1	2	0.393701
0.537627	2	4	0.787402
0.760320	4	8	1.574803
1.075255	3	11	2.165354
1.520640	12	23	4.527559
2.150510	20	43	8.464567
3.041280	35	78	15.354331
4.301019	66	144	28.346457
6.082560	157	301	59.251969
8.602039	207	508	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.5962 in

D15: 2.9955 in

D50: 5.5492 in

D85: 7.6746 in

D100: 8.6020 in

Image Gradation Input Parameters

Name: DSCF0379

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0379.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 184

Morphologic Iterations: 1

Resolution: 32 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.056933	0	0	0.000000
0.080516	0	0	0.000000
0.113867	0	0	0.000000
0.161032	0	0	0.000000
0.227734	0	0	0.000000
0.322064	0	0	0.000000
0.455467	0	0	0.000000
0.644128	0	0	0.000000
0.910935	1	1	0.487805
1.288256	2	3	1.463415
1.821869	6	9	4.390244
2.576512	12	21	10.243902
3.643738	34	55	26.829268
5.153024	24	79	38.536585
7.287476	58	137	66.829268
10.306048	68	205	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.9005 in

D15: 2.8826 in

D50: 6.0178 in

D85: 8.9410 in

D100: 10.3060 in

Image Gradation Input Parameters

Name: DSCF0381

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0381.JPG

- Scale Line Length: 24 in
- Median Filter Radius: 2 px
- Background Subtraction Radius: 3 px
- Advanced Controls:
  - Automate Threshold Selection
  - Threshold Value: 163
  - Morphologic Iterations: 1
  - Resolution: 33 %
  - Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.060500	0	0	0.000000
0.085560	0	0	0.000000
0.121000	0	0	0.000000
0.171120	0	0	0.000000
0.242000	0	0	0.000000
0.342240	0	0	0.000000
0.484000	0	0	0.000000
0.684480	1	1	0.418410
0.968001	1	2	0.836820
1.368960	2	4	1.673640
1.936002	6	10	4.184100
2.737920	5	15	6.276151
3.872004	28	43	17.991632
5.475840	66	109	45.606695
7.744007	39	148	61.924686
10.951680	91	239	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 2.2487 in

D15: 3.5824 in

D50: 6.0865 in

D85: 9.6880 in

D100: 10.9517 in

Image Gradation Input Parameters

Name: DSCF0386

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0386.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 172

Morphologic Iterations: 1

Resolution: 28 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.042732	0	0	0.000000
0.060432	0	0	0.000000
0.085464	0	0	0.000000
0.120864	0	0	0.000000
0.170928	0	0	0.000000
0.241728	0	0	0.000000
0.341855	0	0	0.000000
0.483456	1	1	0.221239
0.683710	3	4	0.884956
0.966912	7	11	2.433628
1.367420	16	27	5.973451
1.933824	37	64	14.159292
2.734840	56	120	26.548673
3.867648	92	212	46.902655
5.469680	195	407	90.044248
7.735296	0	407	90.044248
10.939361	45	452	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.2573 in

D15: 1.9882 in

D50: 3.9827 in

D85: 5.2824 in

D100: 10.9394 in

Image Gradation Input Parameters

Name: DSCF0388

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0388.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 167

Morphologic Iterations: 1

Resolution: 28 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.065907	0	0	0.000000
0.093206	0	0	0.000000
0.131813	0	0	0.000000
0.186412	1	1	0.098912
0.263626	2	3	0.296736
0.372824	5	8	0.791296
0.527253	10	18	1.780415
0.745648	19	37	3.659743
1.054506	35	72	7.121662
1.491296	64	136	13.452028
2.109011	116	252	24.925816
2.982592	197	449	44.411474
4.218022	281	730	72.205737
5.965184	223	953	94.263106
8.436044	58	1011	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.8652 in

D15: 1.5746 in

D50: 3.2310 in

D85: 5.2315 in

D100: 8.4360 in

Image Gradation Input Parameters

Name: DSCF0392

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0392.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 172

Morphologic Iterations: 1

Resolution: 27 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.079332	0	0	0.000000
0.112192	0	0	0.000000
0.158663	0	0	0.000000
0.224384	0	0	0.000000
0.317327	2	2	0.238379
0.448768	3	5	0.595948
0.634654	6	11	1.311085
0.897536	12	23	2.741359
1.269308	22	45	5.363528
1.795072	40	85	10.131108
2.538615	78	163	19.427890
3.590144	137	300	35.756853
5.077230	177	477	56.853397
7.180288	269	746	88.915375
10.154461	93	839	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.2178 in

D15: 2.1845 in

D50: 4.5941 in

D85: 6.9235 in

D100: 10.1545 in

Image Gradation Input Parameters

Name: DSCF0395

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0395.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 167

Morphologic Iterations: 1

Resolution: 28 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.065417	0	0	0.000000
0.092514	0	0	0.000000
0.130835	0	0	0.000000
0.185028	0	0	0.000000
0.261669	1	1	0.149477
0.370056	1	2	0.298954
0.523338	3	5	0.747384
0.740112	6	11	1.644245
1.046676	13	24	3.587444
1.480224	19	43	6.427504
2.093353	40	83	12.406577
2.960448	63	146	21.823617
4.186706	165	311	46.487294
5.920896	142	453	67.713004
8.373411	85	538	80.418535
11.841792	131	669	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.2623 in

D15: 2.3321 in

D50: 4.4737 in

D85: 9.1849 in

D100: 11.8418 in

Image Gradation Input Parameters

Name: DSCF0397

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0397.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 168

Morphologic Iterations: 1

Resolution: 27 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.043555	0	0	0.000000
0.061596	0	0	0.000000
0.087110	0	0	0.000000
0.123192	0	0	0.000000
0.174220	0	0	0.000000
0.246384	0	0	0.000000
0.348440	1	1	0.162602
0.492768	2	3	0.487805
0.696879	5	8	1.300813
0.985536	9	17	2.764228
1.393758	18	35	5.691057
1.971072	39	74	12.032520
2.787517	49	123	20.000000
3.942144	130	253	41.138211
5.575034	126	379	61.626016
7.884288	133	512	83.252033
11.150067	103	615	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.2974 in

D15: 2.2752 in

D50: 4.6484 in

D85: 8.2251 in

D100: 11.1501 in

Image Gradation Input Parameters

Name: DSCF0398

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0398.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 174

Morphologic Iterations: 1

Resolution: 27 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.062503	0	0	0.000000
0.088392	0	0	0.000000
0.125005	0	0	0.000000
0.176784	0	0	0.000000
0.250010	0	0	0.000000
0.353568	1	1	0.155763
0.500021	3	4	0.623053
0.707136	6	10	1.557632
1.000041	12	22	3.426791
1.414272	23	45	7.009346
2.000083	52	97	15.109034
2.828544	52	149	23.208723
4.000165	111	260	40.498442
5.657088	262	522	81.308411
8.000331	120	642	100.000000

One sediment sample was collected from the channel bed near Bridge H-02-S. Results of the sediment size analysis for the sediment sample collected from the channel are presented below in both tabular and graphical formats.

Figure G.4.1.
Photo of sediment sample from the H-02-S site

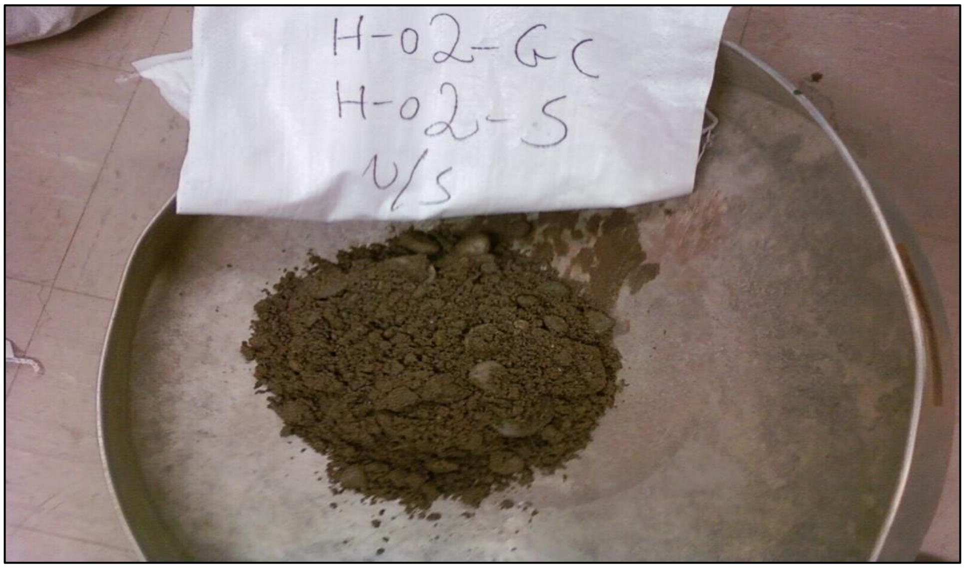


Table G.4.1.
Sediment sieve analysis
Sample ID: H-02-S Colorado River
Sample Description: 1 of 2
Performed by: JE
Date: 9-20-2011

Sieve Size (mm)	% Finer
60	100%
44.45	100%
16	47%
8	44%
4	40%
2	38%
1	38%
0.5	37%
0.125	19%

Figure G.4.2.

Grain size gradation curve for the sediment sample collected from the Colorado River in the vicinity of H-02-S

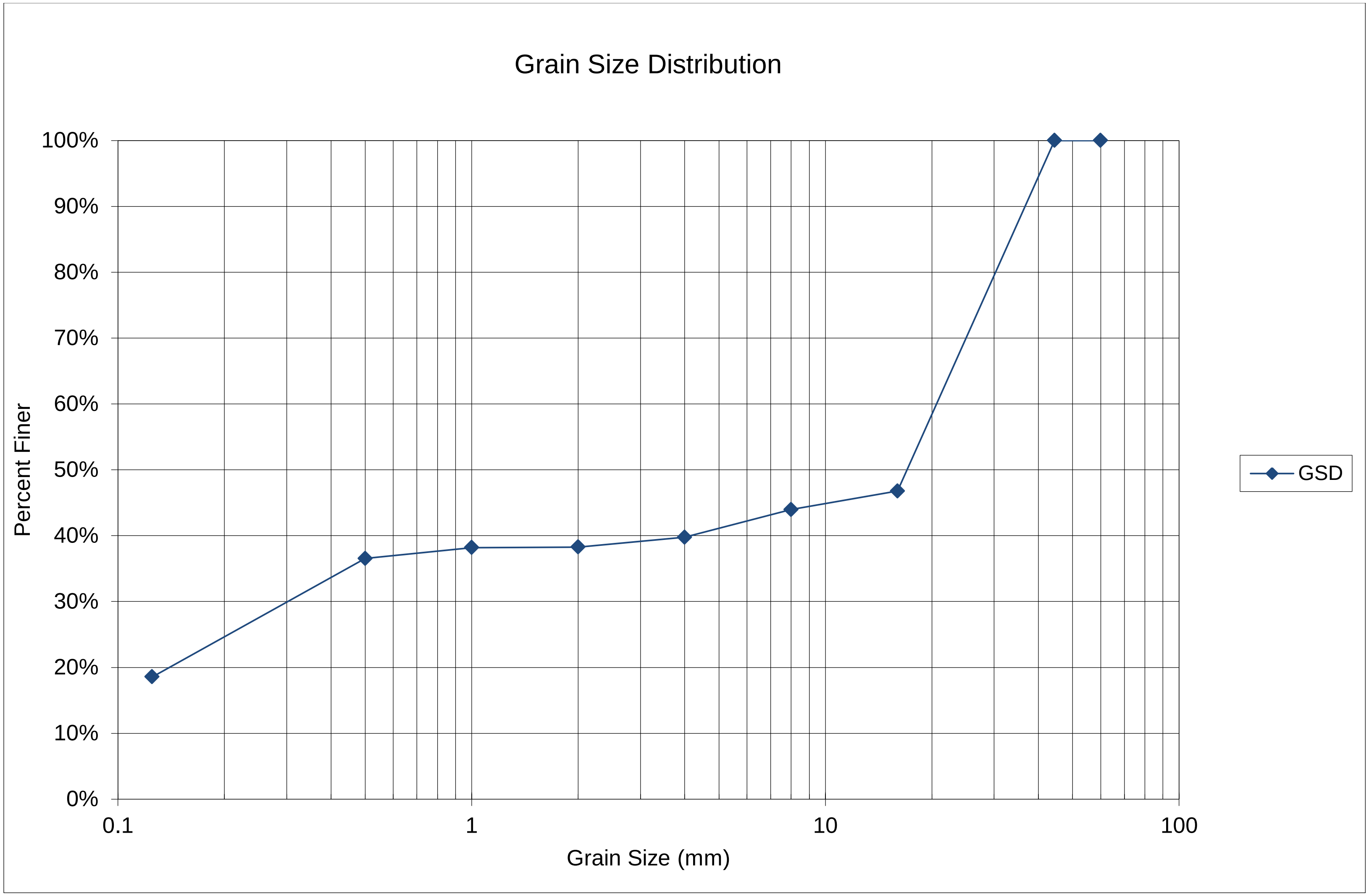


Table G.4.2.
Grain size gradation computations for the sediment sample collected from the Colorado River in the vicinity of H-02-S

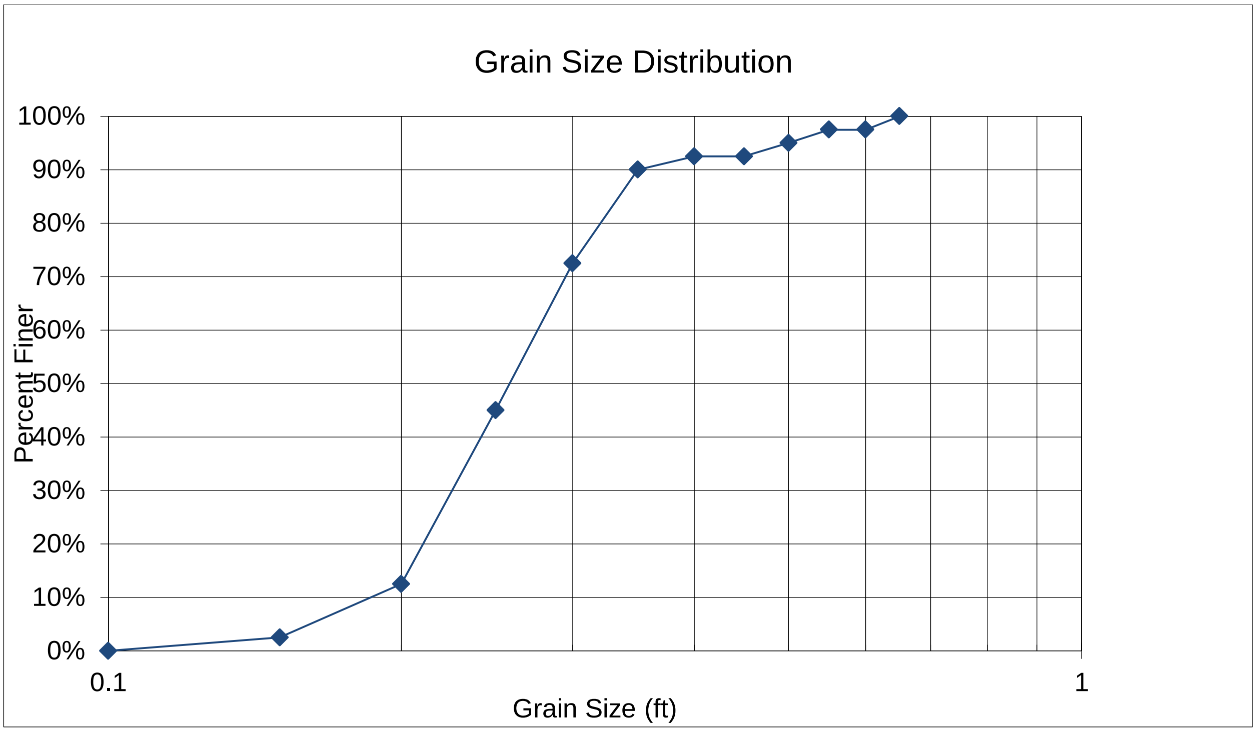
Structure # H-02-S	**Waterbody - Colorado River**	**Sample # 1**	Performed by: JE Date: 10/11/2011			
Sieve Size (mm)	Weight of Sieve (g)	Weight of Sieve + Soil (g)	Weight of Soil (g)	% Retained	Cumulative % Ret.	% Finer
60	0	0	0	0%	0%	100%
44.45	0	0	0	0%	0%	100%
16	535.16	1970.8	1435.64	53%	53%	47%
8	547	623.17	76.17	3%	56%	44%
4	507.62	620.66	113.04	4%	60%	40%
2	487.41	527.47	40.06	1%	62%	38%
1	457.11	459.84	2.73	0%	62%	38%
0.5	445.21	489.66	44.45	2%	63%	37%
0.125	379.11	863.95	484.84	18%	81%	19%
Pan	370.23	870.81	500.58	19%	100%	0%
		Total Weight of Sample	**2697.51**			

Pebble Count Grain Size Distribution

Region	Structure ID	County	Facility Carried	Mile Marker	POA Fiscal Year	Feature Intersected	D_{50} max from POA	Date
3	H-02-S	Mesa	SH 340 ML EBND	12.6	2012	Colorado River	16	8/8/2013

Sample #	A (ft)	B (ft)	C (ft)	Shape Factor	D_s (ft)	D_{avg} (ft)	Volume (ft³)
1	0.36	0.28	0.06	0.189	0.28	0.233	0.003
2	0.25	0.16	0.14	0.700	0.16	0.183	0.003
3	0.34	0.23	0.12	0.429	0.23	0.230	0.005
4	0.43	0.34	0.16	0.418	0.34	0.310	0.012
5	0.39	0.24	0.13	0.425	0.24	0.253	0.006
6	0.49	0.37	0.09	0.211	0.37	0.317	0.009
7	0.3	0.21	0.07	0.279	0.21	0.193	0.002
8	0.51	0.25	0.15	0.420	0.25	0.303	0.010
9	0.31	0.24	0.1	0.367	0.24	0.217	0.004
10	0.91	0.62	0.38	0.506	0.62	0.637	0.112
11	0.33	0.28	0.14	0.461	0.28	0.250	0.007
12	0.33	0.22	0.08	0.297	0.22	0.210	0.003
13	0.27	0.19	0.04	0.177	0.19	0.167	0.001
14	0.27	0.22	0.09	0.369	0.22	0.193	0.003
15	0.61	0.51	0.33	0.592	0.51	0.483	0.054
16	0.32	0.24	0.15	0.541	0.24	0.237	0.006
17	0.33	0.28	0.12	0.395	0.28	0.243	0.006
18	0.37	0.3	0.05	0.150	0.3	0.240	0.003
19	0.36	0.29	0.19	0.588	0.29	0.280	0.010
20	0.38	0.34	0.12	0.334	0.34	0.280	0.008
21	0.53	0.33	0.24	0.574	0.33	0.367	0.022
22	0.54	0.34	0.17	0.397	0.34	0.350	0.016
23	0.35	0.31	0.14	0.425	0.31	0.267	0.008
24	0.23	0.18	0.04	0.197	0.18	0.150	0.001
25	0.41	0.29	0.08	0.232	0.29	0.260	0.005
26	0.39	0.2	0.11	0.394	0.2	0.233	0.004
27	0.41	0.29	0.09	0.261	0.29	0.263	0.006
28	0.3	0.2	0.04	0.163	0.2	0.180	0.001
29	0.33	0.22	0.07	0.260	0.22	0.207	0.003
30	0.56	0.45	0.23	0.458	0.45	0.413	0.030
31	0.49	0.25	0.11	0.314	0.25	0.283	0.007
32	0.28	0.24	0.09	0.347	0.24	0.203	0.003
33	0.4	0.24	0.12	0.387	0.24	0.253	0.006
34	0.31	0.21	0.09	0.353	0.21	0.203	0.003
35	0.29	0.19	0.08	0.341	0.19	0.187	0.002
36	0.36	0.29	0.05	0.155	0.29	0.233	0.003
37	0.28	0.25	0.08	0.302	0.25	0.203	0.003
38	0.44	0.34	0.13	0.336	0.34	0.303	0.010
39	0.3	0.25	0.07	0.256	0.25	0.207	0.003
40	0.25	0.13	0.06	0.333	0.13	0.147	0.001

Structure # H-02-S	Colorado River at SH 340 EBND			
Sieve Size (ft)	Samples Retained	% Retained	Cumulative % Ret.	% Finer
0.65	0	0%	0%	100%
0.6	1	3%	3%	98%
0.55	0	0%	3%	98%
0.5	1	3%	5%	95%
0.45	1	3%	8%	93%
0.4	0	0%	8%	93%
0.35	1	3%	10%	90%
0.3	7	18%	28%	73%
0.25	11	28%	55%	45%
0.2	13	33%	88%	13%
0.15	4	10%	98%	3%
0.1	1	3%	100%	0%
Total Samples	40			



Hydraulic Analysis Report

Project Data

Project Title: H-02-GC & S

Designer:

Project Date: Thursday, September 19, 2013

Project Units: U.S. Customary Units

Notes:

Wolman Count Analysis: Hydraulic Toolbox GSD

Notes:

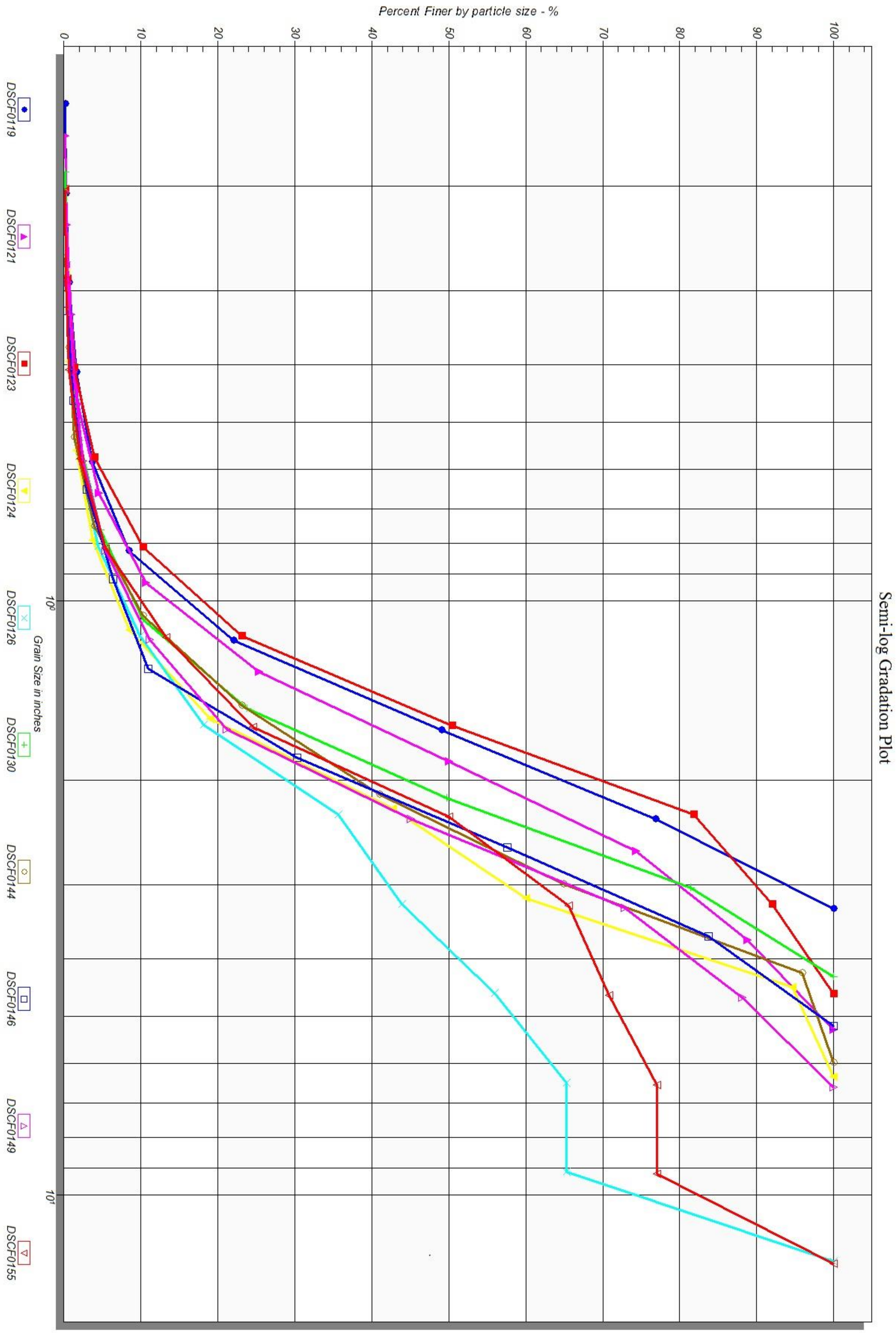

Semi-log Gradation Plot
Percent Finer by particle size - %
0
10
20
30
40
50
60
70
80
90
100
Grain Size in inches
10^0
10^1
DSCF0119
DSCF0121
DSCF0123
DSCF0124
DSCF0126
DSCF0130
DSCF0144
DSCF0146
DSCF0149
DSCF0155

Image Gradation Input Parameters

Name: DSCF0119

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0119.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 175

Morphologic Iterations: 1

Resolution: 31 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.025726	0	0	0.000000
0.036381	0	0	0.000000
0.051451	0	0	0.000000
0.072763	0	0	0.000000
0.102902	0	0	0.000000
0.145526	1	1	0.134048
0.205804	1	2	0.268097
0.291051	3	5	0.670241
0.411609	7	12	1.608579
0.582103	15	27	3.619303
0.823218	36	63	8.445040
1.164205	101	164	21.983914
1.646435	202	366	49.061662
2.328411	207	573	76.809651
3.292870	173	746	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.6511 in

D15: 0.9883 in

D50: 1.6695 in

D85: 2.6690 in

D100: 3.2929 in

Image Gradation Input Parameters

Name: DSCF0121

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0121.JPG

- *Scale Line Length: 24 in*
- *Median Filter Radius: 2 px*
- *Background Subtraction Radius: 3 px*
- *Advanced Controls:*
  - *Automate Threshold Selection*
  - *Threshold Value: 189*
  - *Morphologic Iterations: 1*
  - *Resolution: 31 %*
  - *Flood Depth: 0.9 px*

Gradation Results

Particle Size in	*Particle count*	*Cumulative Particle count*	*Cumulative Percent Finer (%)*
0.029101	*0*	*0*	*0.000000*
0.041155	*0*	*0*	*0.000000*
0.058202	*0*	*0*	*0.000000*
0.082310	*0*	*0*	*0.000000*
0.116404	*0*	*0*	*0.000000*
0.164620	*1*	*1*	*0.111982*
0.232808	*2*	*3*	*0.335946*
0.329240	*5*	*8*	*0.895857*
0.465615	*8*	*16*	*1.791713*
0.658479	*24*	*40*	*4.479283*
0.931230	*55*	*95*	*10.638298*
1.316959	*131*	*226*	*25.307951*
1.862461	*221*	*447*	*50.055991*
2.633917	*217*	*664*	*74.356103*
3.724922	*129*	*793*	*88.801792*
5.267835	*100*	*893*	*100.000000*

Gradation Result Parameters

Gradation Result Parameters

D5: 0.6815 in

D15: 1.0459 in

D50: 1.8612 in

D85: 3.4378 in

D100: 5.2678 in

Image Gradation Input Parameters

Name: DSCF0123

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0123.JPG

- *Scale Line Length: 24 in*
- *Median Filter Radius: 2 px*
- *Background Subtraction Radius: 3 px*
- *Advanced Controls:*
  - *Automate Threshold Selection*
  - *Threshold Value: 200*
  - *Morphologic Iterations: 1*
  - *Resolution: 34 %*
  - *Flood Depth: 0.9 px*

Gradation Results

Particle Size in	*Particle count*	*Cumulative Particle count*	*Cumulative Percent Finer (%)*
0.025299	*0*	*0*	*0.000000*
0.035778	*0*	*0*	*0.000000*
0.050598	*0*	*0*	*0.000000*
0.071557	*0*	*0*	*0.000000*
0.101196	*0*	*0*	*0.000000*
0.143113	*0*	*0*	*0.000000*
0.202393	*1*	*1*	*0.147059*
0.286227	*2*	*3*	*0.441176*
0.404786	*6*	*9*	*1.323529*
0.572454	*18*	*27*	*3.970588*
0.809572	*43*	*70*	*10.294118*
1.144908	*87*	*157*	*23.088235*
1.619144	*186*	*343*	*50.441176*
2.289815	*213*	*556*	*81.764706*
3.238288	*70*	*626*	*92.058824*
4.579630	*54*	*680*	*100.000000*

Gradation Result Parameters

Gradation Result Parameters

D5: 0.6111 in

D15: 0.9329 in

D50: 1.6115 in

D85: 2.5879 in

D100: 4.5796 in

Image Gradation Input Parameters

Name: DSCF0124

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Z:\CDOT Bridge Pier Scour\Hydraulic Toolbox GSDs\H-02-GC & S\Analyzed Photos\DSCF0124.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 156

Morphologic Iterations: 1

Resolution: 33 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.024689	0	0	0.000000
0.034916	0	0	0.000000
0.049378	0	0	0.000000
0.069831	0	0	0.000000
0.098756	0	0	0.000000
0.139663	0	0	0.000000
0.197513	0	0	0.000000
0.279325	1	1	0.197628
0.395026	2	3	0.592885
0.558651	5	8	1.581028
0.790051	11	19	3.754941
1.117301	24	43	8.498024
1.580103	53	96	18.972332
2.234603	120	216	42.687747
3.160206	88	304	60.079051
4.469206	175	479	94.664032
6.320411	27	506	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.8760 in

D15: 1.4046 in

D50: 2.6238 in

D85: 4.1034 in

D100: 6.3204 in

Image Gradation Input Parameters

Name: DSCF0126

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Z:\CDOT Bridge Pier Scour\Hydraulic Toolbox GSDs\H-02-GC & S\Analyzed Photos\DSCF0126.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 183

Morphologic Iterations: 1

Resolution: 30 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	*Particle count*	*Cumulative Particle count*	*Cumulative Percent Finer (%)*
0.035718	*0*	*0*	*0.000000*
0.050513	*0*	*0*	*0.000000*
0.071436	*0*	*0*	*0.000000*
0.101025	*0*	*0*	*0.000000*
0.142872	*0*	*0*	*0.000000*
0.202051	*1*	*1*	*0.169492*
0.285743	*1*	*2*	*0.338983*
0.404102	*3*	*5*	*0.847458*
0.571486	*6*	*11*	*1.864407*
0.808203	*15*	*26*	*4.406780*
1.142972	*32*	*58*	*9.830508*
1.616407	*49*	*107*	*18.135593*
2.285944	*103*	*210*	*35.593220*
3.232813	*49*	*259*	*43.898305*
4.571888	*71*	*330*	*55.932203*
6.465627	*55*	*385*	*65.254237*
9.143777	*0*	*385*	*65.254237*
12.931253	*205*	*590*	*100.000000*

Gradation Result Parameters

Gradation Result Parameters

D5: 0.8448 in

D15: 1.4377 in

D50: 3.9118 in

D85: 11.2962 in

D100: 12.9313 in

Image Gradation Input Parameters

Name: DSCF0130

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Z:\CDOT Bridge Pier Scour\Hydraulic Toolbox GSDs\H-02-GC & S\Analyzed Photos\DSCF0130.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 180

Morphologic Iterations: 1

Resolution: 32 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	*Particle count*	*Cumulative Particle count*	*Cumulative Percent Finer (%)*
0.033521	*0*	*0*	*0.000000*
0.047405	*0*	*0*	*0.000000*
0.067041	*0*	*0*	*0.000000*
0.094811	*0*	*0*	*0.000000*
0.134082	*0*	*0*	*0.000000*
0.189621	*1*	*1*	*0.152672*
0.268165	*1*	*2*	*0.305344*
0.379242	*3*	*5*	*0.763359*
0.536329	*8*	*13*	*1.984733*
0.758484	*18*	*31*	*4.732824*
1.072658	*36*	*67*	*10.229008*
1.516968	*89*	*156*	*23.816794*
2.145317	*170*	*326*	*49.770992*
3.033936	*207*	*533*	*81.374046*
4.290634	*122*	*655*	*100.000000*

Gradation Result Parameters

Gradation Result Parameters

D5: 0.7738 in

D15: 1.2287 in

D50: 2.1518 in

D85: 3.2786 in

D100: 4.2906 in

Image Gradation Input Parameters

Name: DSCF0144

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Z:\CDOT Bridge Pier Scour\Hydraulic Toolbox GSDs\H-02-GC & S\Analyzed Photos\DSCF0144.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 187

Morphologic Iterations: 1

Resolution: 29 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	*Particle count*	*Cumulative Particle count*	*Cumulative Percent Finer (%)*
0.033063	*0*	*0*	*0.000000*
0.046758	*0*	*0*	*0.000000*
0.066126	*0*	*0*	*0.000000*
0.093516	*0*	*0*	*0.000000*
0.132252	*0*	*0*	*0.000000*
0.187033	*0*	*0*	*0.000000*
0.264504	*1*	*1*	*0.150150*
0.374065	*3*	*4*	*0.600601*
0.529008	*5*	*9*	*1.351351*
0.748131	*17*	*26*	*3.903904*
1.058017	*42*	*68*	*10.210210*
1.496262	*86*	*154*	*23.123123*
2.116033	*119*	*273*	*40.990991*
2.992523	*159*	*432*	*64.864865*
4.232067	*207*	*639*	*95.945946*
5.985046	*27*	*666*	*100.000000*

Gradation Result Parameters

Gradation Result Parameters

D5: 0.8020 in

D15: 1.2206 in

D50: 2.4468 in

D85: 3.7955 in

D100: 5.9850 in

Image Gradation Input Parameters

Name: DSCF0146

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Z:\CDOT Bridge Pier Scour\Hydraulic Toolbox GSDs\H-02-GC & S\Analyzed Photos\DSCF0146.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 160

Morphologic Iterations: 1

Resolution: 33 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	*Particle count*	*Cumulative Particle count*	*Cumulative Percent Finer (%)*
0.028686	*0*	*0*	*0.000000*
0.040569	*0*	*0*	*0.000000*
0.057373	*0*	*0*	*0.000000*
0.081137	*0*	*0*	*0.000000*
0.114745	*0*	*0*	*0.000000*
0.162275	*0*	*0*	*0.000000*
0.229491	*0*	*0*	*0.000000*
0.324549	*2*	*2*	*0.396040*
0.458982	*4*	*6*	*1.188119*
0.649098	*9*	*15*	*2.970297*
0.917964	*17*	*32*	*6.336634*
1.298197	*23*	*55*	*10.891089*
1.835927	*98*	*153*	*30.297030*
2.596393	*138*	*291*	*57.623762*
3.671855	*132*	*423*	*83.762376*
5.192787	*82*	*505*	*100.000000*

Gradation Result Parameters

Gradation Result Parameters

D5: 0.8112 in

D15: 1.4121 in

D50: 2.3842 in

D85: 3.7878 in

D100: 5.1928 in

Image Gradation Input Parameters

Name: DSCF0149

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Z:\CDOT Bridge Pier Scour\Hydraulic Toolbox GSDs\H-02-GC & S\Analyzed Photos\DSCF0149.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 203

Morphologic Iterations: 1

Resolution: 31 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	*Particle count*	*Cumulative Particle count*	*Cumulative Percent Finer (%)*
0.036329	*0*	*0*	*0.000000*
0.051378	*0*	*0*	*0.000000*
0.072659	*0*	*0*	*0.000000*
0.102755	*0*	*0*	*0.000000*
0.145318	*0*	*0*	*0.000000*
0.205510	*2*	*2*	*0.182648*
0.290636	*4*	*6*	*0.547945*
0.411021	*7*	*13*	*1.187215*
0.581271	*14*	*27*	*2.465753*
0.822042	*32*	*59*	*5.388128*
1.162543	*63*	*122*	*11.141553*
1.644084	*110*	*232*	*21.187215*
2.325086	*261*	*493*	*45.022831*
3.288168	*305*	*798*	*72.876712*
4.650172	*167*	*965*	*88.127854*
6.576336	*130*	*1095*	*100.000000*

Gradation Result Parameters

Gradation Result Parameters

D5: 0.7901 in

D15: 1.3475 in

D50: 2.4972 in

D85: 4.3708 in

D100: 6.5763 in

Image Gradation Input Parameters

Name: DSCF0155

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Z:\CDOT Bridge Pier Scour\Hydraulic Toolbox GSDs\H-02-GC & S\Analyzed Photos\DSCF0155.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 192

Morphologic Iterations: 1

Resolution: 29 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.036013	0	0	0.000000
0.050930	0	0	0.000000
0.072027	0	0	0.000000
0.101861	0	0	0.000000
0.144053	0	0	0.000000
0.203722	1	1	0.124844
0.288106	1	2	0.249688
0.407444	3	5	0.624220
0.576212	12	17	2.122347
0.814887	26	43	5.368290
1.152425	63	106	13.233458
1.629775	91	197	24.594257
2.304850	204	401	50.062422
3.259550	124	525	65.543071
4.609699	42	567	70.786517
6.519099	50	617	77.028714
9.219399	0	617	77.028714
13.038199	184	801	100.000000

Sediment particles in the channel bed near Structure H-04-G consist of gravel, cobbles, and boulders.

Figure G.5.1.
Photo of cobbles and boulders from the H-04-G bridge site

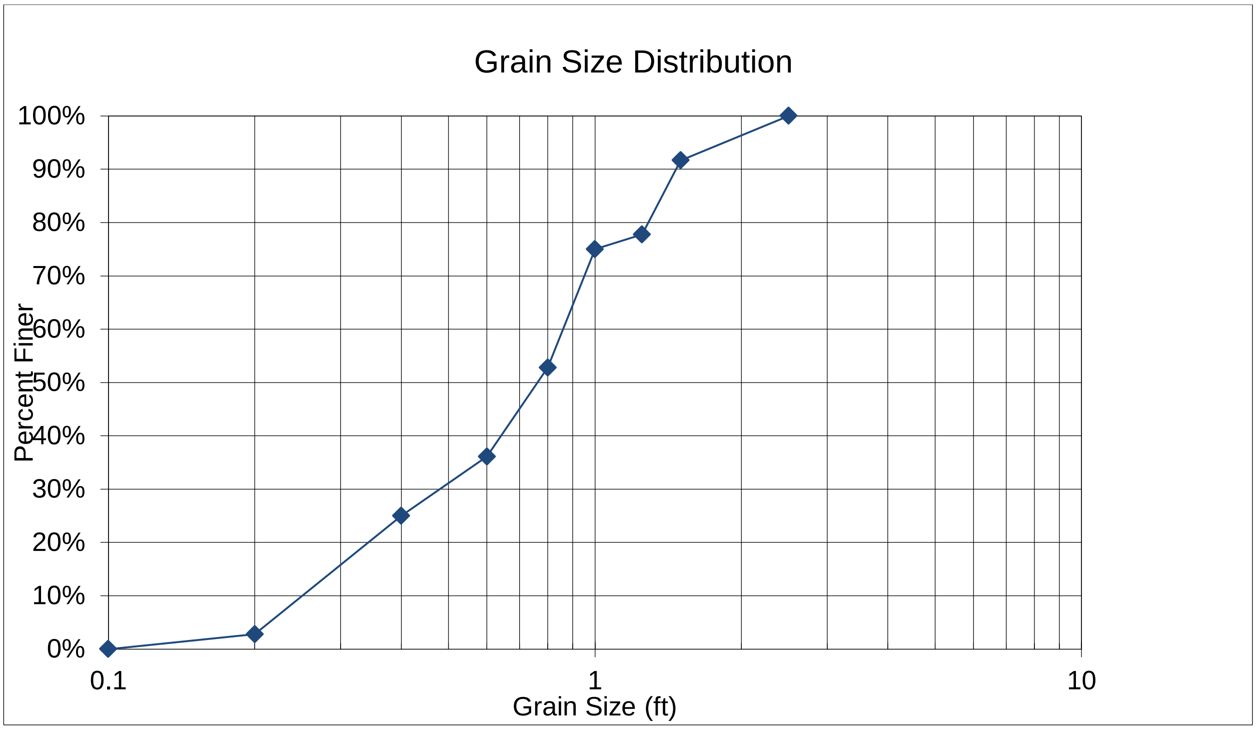
Figure G.5.2.
Photo of cobbles and boulders from the H-04-G bridge site

Pebble Count Grain Size Distribution

Region	Structure ID	County	Facility Carried	Mile Marker	POA Fiscal Year	Feature Intersected	Date
3	H-04-G	Mesa	SH 330 ML	8.7	2013	Big Creek	9/12/2013

Sample #	A (ft)	B (ft)	C (ft)	Shape Factor	D_s (ft)	D_{avg} (ft)	Volume (ft³)
1	2.8	1.3	1	0.524	1.3	1.700	1.906
2	0.65	0.55	0.3	0.502	0.55	0.500	0.056
3	0.5	0.3	0.2	0.516	0.3	0.333	0.016
4	0.9	0.55	0.5	0.711	0.55	0.650	0.130
5	0.5	0.26	0.25	0.693	0.26	0.337	0.017
6	0.2	0.16	0.11	0.615	0.16	0.157	0.002
7	0.84	0.72	0.42	0.540	0.72	0.660	0.133
8	0.94	0.72	0.41	0.498	0.72	0.690	0.145
9	0.72	0.55	0.42	0.667	0.55	0.563	0.087
10	0.47	0.26	0.17	0.486	0.26	0.300	0.011
11	1.13	0.8	0.55	0.578	0.8	0.827	0.260
12	1.05	0.92	0.52	0.529	0.92	0.830	0.263
13	0.57	0.3	0.23	0.556	0.3	0.367	0.021
14	0.65	0.6	0.58	0.929	0.6	0.610	0.118
15	0.5	0.3	0.24	0.620	0.3	0.347	0.019
16	0.37	0.37	0.22	0.595	0.37	0.320	0.016
17	0.38	0.2	0.17	0.617	0.2	0.250	0.007
18	1.23	0.85	0.65	0.636	0.85	0.910	0.356
19	0.92	0.7	0.3	0.374	0.7	0.640	0.101
20	1.04	0.63	0.29	0.358	0.63	0.653	0.099
21	0.9	0.8	0.6	0.707	0.8	0.767	0.226
22	2.4	1.75	0.75	0.366	1.75	1.633	1.649
23	0.65	0.44	0.23	0.430	0.44	0.440	0.034
24	0.38	0.32	0.25	0.717	0.32	0.317	0.016
25	3	2.3	2.2	0.838	2.3	2.500	7.948
26	1.07	0.68	0.3	0.352	0.68	0.683	0.114
27	1.1	0.8	0.4	0.426	0.8	0.767	0.184
28	1.5	0.8	0.4	0.365	0.8	0.900	0.251
29	1.1	0.8	0.35	0.373	0.8	0.750	0.161
30	1.5	1.45	0.65	0.441	1.45	1.200	0.740
31	1.5	1.35	0.4	0.281	1.35	1.083	0.424
32	1.75	1.4	0.4	0.256	1.4	1.183	0.513
33	1.4	1.35	0.6	0.436	1.35	1.117	0.594
34	1.2	0.9	0.75	0.722	0.9	0.950	0.424
35	1.6	1.2	0.75	0.541	1.2	1.183	0.754
36	2.3	1.7	1.3	0.657	1.7	1.767	2.661

Structure # H-04-G	Big Creek at SH 330			
Sieve Size (ft)	Samples Retained	% Retained	Cumulative % Ret.	% Finer
2.5	0	0%	0%	100%
1.5	3	8%	8%	92%
1.25	5	14%	22%	78%
1	1	3%	25%	75%
0.8	8	22%	47%	53%
0.6	6	17%	64%	36%
0.4	4	11%	75%	25%
0.2	8	22%	97%	3%
0.1	1	3%	100%	0%
Total Samples	36			



Hydraulic Analysis Report

Project Data

Project Title: H-04-G

Designer:

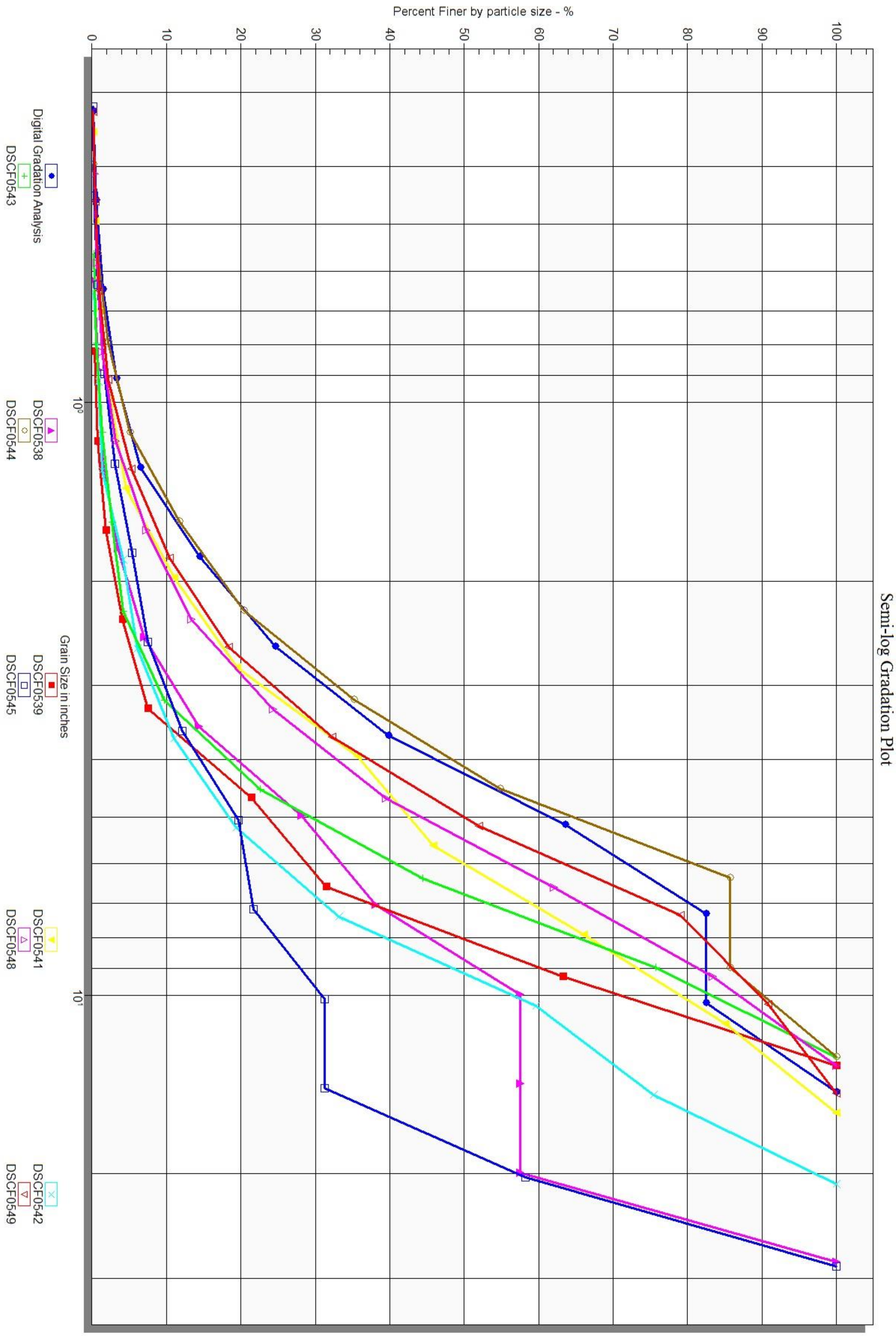
Project Date: Thursday, September 19, 2013

Project Units: U.S. Customary Units

Notes:

Wolman Count Analysis: Hydraulic Toolbox GSD

Notes:



Semi-log Gradation Plot
Percent Finer by particle size - %
0
10
20
30
40
50
60
70
80
90
100
Grain Size in inches
10^0
10^1
Digital Gradation Analysis
DSCF0543
DSCF0538
DSCF0544
DSCF0539
DSCF0545
DSCF0541
DSCF0548
DSCF0542
DSCF0549

Image Gradation Input Parameters

Name: Digital Gradation Analysis

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0537.JPG

Scale Line Length: 48 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 168

Morphologic Iterations: 1

Resolution: 29 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.080517	0	0	0.000000
0.113868	0	0	0.000000
0.161034	0	0	0.000000
0.227736	0	0	0.000000
0.322067	1	1	0.143266
0.455472	3	4	0.573066
0.644135	6	10	1.432665
0.910944	13	23	3.295129
1.288269	22	45	6.446991
1.821888	56	101	14.469914
2.576539	71	172	24.641834
3.643776	106	278	39.828080
5.153077	166	444	63.610315
7.287552	132	576	82.521490
10.306155	0	576	82.521490
14.575104	122	698	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.1150 in

D15: 1.8612 in

D50: 4.2893 in

D85: 10.9115 in

D100: 14.5751 in

Image Gradation Input Parameters

Name: DSCF0538

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0538.JPG

Scale Line Length: 48 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 164

Morphologic Iterations: 1

Resolution: 29 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.077845	0	0	0.000000
0.110090	0	0	0.000000
0.155691	0	0	0.000000
0.220180	0	0	0.000000
0.311382	0	0	0.000000
0.440360	0	0	0.000000
0.622763	1	1	0.270270
0.880720	2	3	0.810811
1.245526	2	5	1.351351
1.761440	8	13	3.513514
2.491052	13	26	7.027027
3.522880	27	53	14.324324
4.982105	51	104	28.108108
7.045760	37	141	38.108108
9.964209	72	213	57.567568
14.091520	0	213	57.567568
19.928419	0	213	57.567568
28.183040	157	370	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 2.0701 in

D15: 3.5944 in

D50: 8.8293 in

D85: 25.2650 in

D100: 28.1830 in

Image Gradation Input Parameters

Name: DSCF0539

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0539.JPG

Scale Line Length: 48 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 161

Morphologic Iterations: 1

Resolution: 27 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.102641	0	0	0.000000
0.145156	0	0	0.000000
0.205282	0	0	0.000000
0.290312	0	0	0.000000
0.410563	0	0	0.000000
0.580624	0	0	0.000000
0.821126	1	1	0.374532
1.161248	1	2	0.749064
1.642253	3	5	1.872659
2.322496	6	11	4.119850
3.284505	9	20	7.490637
4.644992	37	57	21.348315
6.569011	27	84	31.460674
9.289984	85	169	63.295880
13.138021	98	267	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 2.5737 in

D15: 4.0217 in

D50: 8.1536 in

D85: 11.5654 in

D100: 13.1380 in

Image Gradation Input Parameters

Name: DSCF0541

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0541.JPG

Scale Line Length: 48 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 205

Morphologic Iterations: 1

Resolution: 33 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.043670	0	0	0.000000
0.061758	0	0	0.000000
0.087339	0	0	0.000000
0.123516	0	0	0.000000
0.174678	0	0	0.000000
0.247032	0	0	0.000000
0.349356	1	1	0.153374
0.494064	2	3	0.460123
0.698712	3	6	0.920245
0.988128	10	16	2.453988
1.397424	14	30	4.601227
1.976256	42	72	11.042945
2.794848	55	127	19.478528
3.952512	106	233	35.736196
5.589696	66	299	45.858896
7.905024	132	431	66.104294
11.179392	124	555	85.122699
15.810048	97	652	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.4333 in

D15: 2.3603 in

D50: 6.0633 in

D85: 11.1583 in

D100: 15.8100 in

Image Gradation Input Parameters

Name: DSCF0542

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0542.JPG

Scale Line Length: 48 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 182

Morphologic Iterations: 1

Resolution: 27 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.081428	0	0	0.000000
0.115156	0	0	0.000000
0.162855	0	0	0.000000
0.230312	0	0	0.000000
0.325710	0	0	0.000000
0.460624	0	0	0.000000
0.651421	1	1	0.276243
0.921248	2	3	0.828729
1.302841	2	5	1.381215
1.842496	10	15	4.143646
2.605683	7	22	6.077348
3.684992	18	40	11.049724
5.211366	30	70	19.337017
7.369984	50	120	33.149171
10.422731	96	216	59.668508
14.739968	57	273	75.414365
20.845463	89	362	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 2.1805 in

D15: 4.4126 in

D50: 9.3098 in

D85: 17.1204 in

D100: 20.8455 in

Image Gradation Input Parameters

Name: DSCF0543

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0543.JPG

Scale Line Length: 48 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 197

Morphologic Iterations: 1

Resolution: 28 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.070251	0	0	0.000000
0.099350	0	0	0.000000
0.140502	0	0	0.000000
0.198700	0	0	0.000000
0.281004	0	0	0.000000
0.397400	0	0	0.000000
0.562008	1	1	0.263158
0.794800	1	2	0.526316
1.124017	3	5	1.315789
1.589600	5	10	2.631579
2.248034	6	16	4.210526
3.179200	21	37	9.736842
4.496068	49	86	22.631579
6.358400	83	169	44.473684
8.992136	119	288	75.789474
12.716800	92	380	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 2.3811 in

D15: 3.7167 in

D50: 6.8232 in

D85: 10.4091 in

D100: 12.7168 in

Image Gradation Input Parameters

Name: DSCF0544

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0544.JPG

Scale Line Length: 48 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 152

Morphologic Iterations: 1

Resolution: 39 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.070079	0	0	0.000000
0.099106	0	0	0.000000
0.140157	0	0	0.000000
0.198212	0	0	0.000000
0.280314	0	0	0.000000
0.396424	1	1	0.195695
0.560628	3	4	0.782779
0.792848	7	11	2.152642
1.121256	15	26	5.088063
1.585696	34	60	11.741683
2.242513	44	104	20.352250
3.171392	76	180	35.225049
4.485026	100	280	54.794521
6.342784	158	438	85.714286
8.970051	0	438	85.714286
12.685568	73	511	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.1114 in

D15: 1.8342 in

D50: 4.1632 in

D85: 6.2999 in

D100: 12.6856 in

Image Gradation Input Parameters

Name: DSCF0545

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0545.JPG

Scale Line Length: 48 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 182

Morphologic Iterations: 1

Resolution: 29 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.079196	0	0	0.000000
0.112000	0	0	0.000000
0.158392	0	0	0.000000
0.224000	0	0	0.000000
0.316784	1	1	0.129199
0.448000	1	2	0.258398
0.633568	4	6	0.775194
0.896000	7	13	1.679587
1.267135	11	24	3.100775
1.792000	18	42	5.426357
2.534271	16	58	7.493540
3.584000	36	94	12.144703
5.068541	58	152	19.638243
7.168000	16	168	21.705426
10.137083	74	242	31.266150
14.336000	0	242	31.266150
20.274166	209	451	58.268734
28.672000	323	774	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.6958 in

D15: 4.1497 in

D50: 18.4558 in

D85: 25.6535 in

D100: 28.6720 in

Image Gradation Input Parameters

Name: DSCF0548

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0548.JPG

Scale Line Length: 48 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 175

Morphologic Iterations: 1

Resolution: 27 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.072696	0	0	0.000000
0.102808	0	0	0.000000
0.145392	0	0	0.000000
0.205616	0	0	0.000000
0.290785	0	0	0.000000
0.411232	2	2	0.302572
0.581570	2	4	0.605144
0.822464	5	9	1.361573
1.163140	12	21	3.177005
1.644928	27	48	7.261725
2.326279	40	88	13.313162
3.289856	73	161	24.357035
4.652559	100	261	39.485628
6.579712	149	410	62.027231
9.305118	141	551	83.358548
13.159424	110	661	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.3782 in

D15: 2.4735 in

D50: 5.5515 in

D85: 9.6853 in

D100: 13.1594 in

Image Gradation Input Parameters

Name: DSCF0549

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0549.JPG

Scale Line Length: 48 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 183

Morphologic Iterations: 1

Resolution: 27 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.080924	0	0	0.000000
0.114444	0	0	0.000000
0.161848	0	0	0.000000
0.228888	0	0	0.000000
0.323697	1	1	0.109890
0.457776	3	4	0.439560
0.647393	5	9	0.989011
0.915552	11	20	2.197802
1.294786	28	48	5.274725
1.831104	47	95	10.439560
2.589572	72	167	18.351648
3.662208	127	294	32.307692
5.179144	179	473	51.978022
7.324416	247	720	79.120879
10.358288	107	827	90.879121
14.648832	83	910	100.000000

Two sediment samples were collected from the channel bed near Bridge H-04-S. Results of the sediment size analysis for the sediment sample collected from the channel are presented below in both tabular and graphical formats.

Figure G.6.1.
Photo of sediment sample from the H-04-S site

Table G.6.1.
Sediment sieve analysis
Sample ID: H-04-S Plateau Creek
Sample Description: 1 of 2
Performed by: JE
Date: 9-20-2011

Sieve Size (mm)	% Finer
60	100%
31.75	100%
16	86%
4	63%
2	52%
0.5	26%
0.25	3%
0.125	1%

Figure G.6.2.
Grain size gradation curve for the sediment sample collected from Plateau Creek in the vicinity of H-04-S

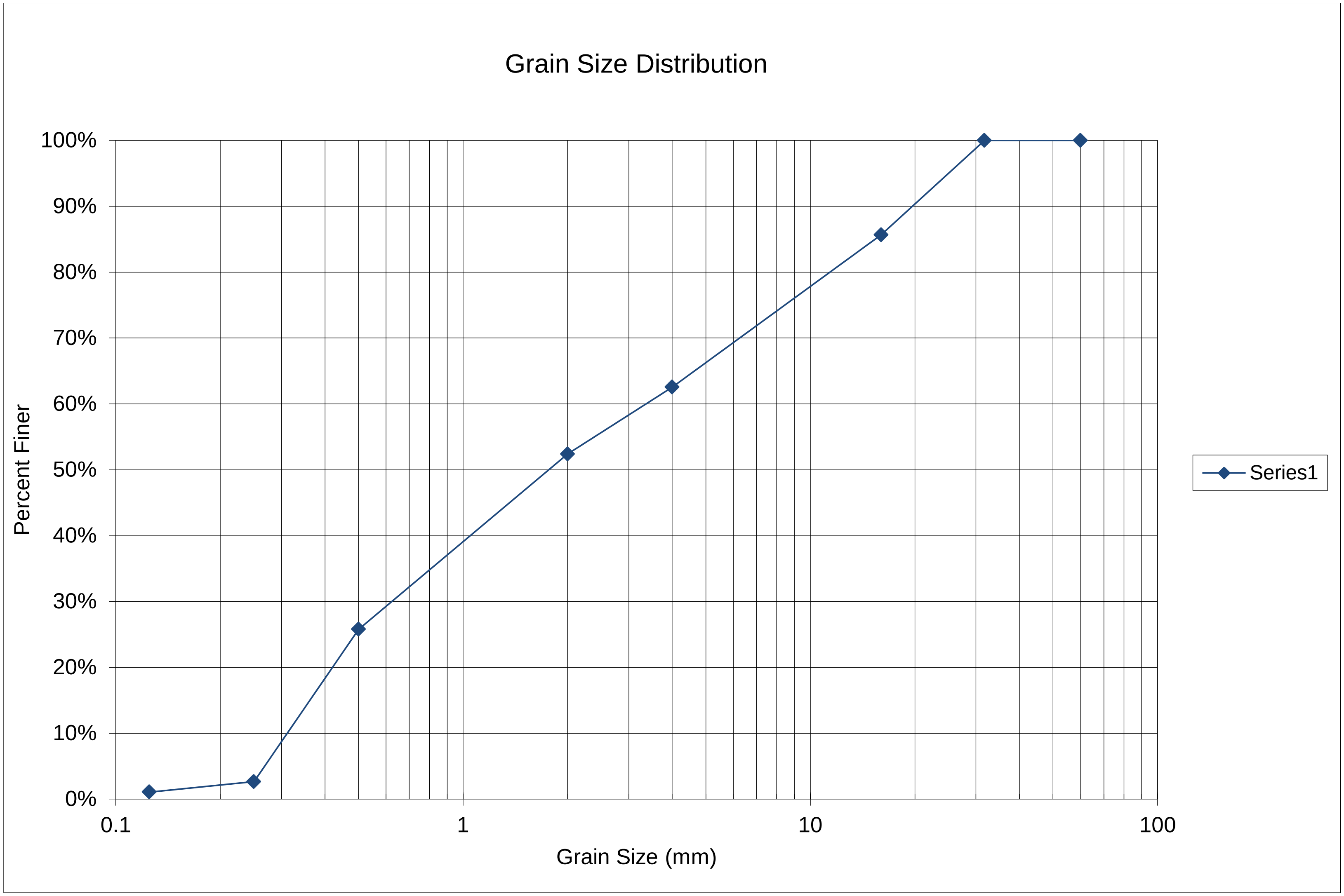


Table G.6.2.

Grain size gradation computations for the sediment sample collected from Plateau Creek in the vicinity of H-04-S

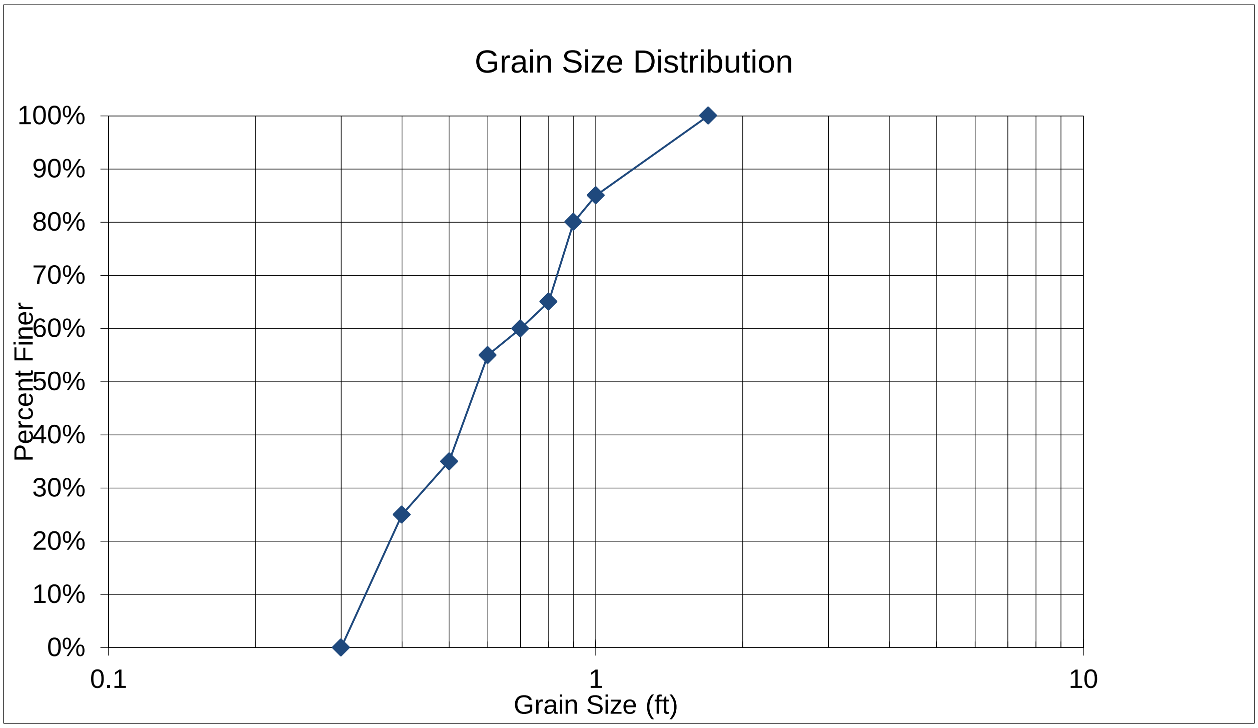
Structure # H-04-S	**Waterbody - Plateau Creek**	**Sample # 1 of 1**	Performed by: JE Date: 10/03/2011			
Sieve Size (mm)	Weight of Sieve (g)	Weight of Sieve + Soil (g)	Weight of Soil (g)	% Retained	Cumulative % Ret.	% Finer
60	0	0	0	0%	0%	100%
31.75	0	2654.1	0	0%	0%	100%
16	542.49	830.84	288.35	14%	14%	86%
4	610.92	1076.8	465.88	23%	37%	63%
2	524.06	728.41	204.35	10%	48%	52%
0.5	484.03	1019.7	535.67	27%	74%	26%
0.25	418.39	884.03	465.64	23%	97%	3%
0.125	379.13	410.92	31.79	2%	99%	1%
Pan	373.41	394.88	21.47	1%	100%	0%
		Total Weight of Sample	**2013.15**			

Pebble Count Grain Size Distribution

Region	Structure ID	County	Facility Carried	Mile Marker	POA Fiscal Year	Feature Intersected	D_{50} max from POA	Date
3	H-04-S	Mesa	SH 330ML	1.9	2012	Plateau Creek	2	8/8/2013

Sample #	A (ft)	B (ft)	C (ft)	Shape Factor	D_s (ft)	D_{avg} (ft)	Volume (ft³)
1	1.7	1.6	1.1	0.667	1.6	1.467	1.567
2	0.97	0.71	0.43	0.518	0.71	0.703	0.155
3	1.12	0.85	0.42	0.430	0.85	0.797	0.209
4	1.2	0.8	0.28	0.286	0.8	0.760	0.141
5	0.42	0.35	0.26	0.678	0.35	0.343	0.020
6	0.63	0.54	0.36	0.617	0.54	0.510	0.064
7	0.62	0.54	0.15	0.259	0.54	0.437	0.026
8	1.1	1	0.7	0.667	1	0.933	0.403
9	0.66	0.4	0.3	0.584	0.4	0.453	0.041
10	0.78	0.47	0.3	0.495	0.47	0.517	0.058
11	0.68	0.37	0.24	0.478	0.37	0.430	0.032
12	1.5	1	0.6	0.490	1	1.033	0.471
13	0.6	0.38	0.34	0.712	0.38	0.440	0.041
14	1.35	0.95	0.42	0.371	0.95	0.907	0.282
15	0.68	0.55	0.35	0.572	0.55	0.527	0.069
16	0.55	0.52	0.26	0.486	0.52	0.443	0.039
17	0.55	0.34	0.16	0.370	0.34	0.350	0.016
18	0.85	0.64	0.36	0.488	0.64	0.617	0.103
19	0.41	0.38	0.33	0.836	0.38	0.373	0.027
20	1.1	0.85	0.63	0.652	0.85	0.860	0.308

Structure # H-04-S	Plateau Creek at SH 330			
Sieve Size (ft)	Samples Retained	% Retained	Cumulative % Ret.	% Finer
1.7	0	0%	0%	100%
1	3	15%	15%	85%
0.9	1	5%	20%	80%
0.8	3	15%	35%	65%
0.7	1	5%	40%	60%
0.6	1	5%	45%	55%
0.5	4	20%	65%	35%
0.4	2	10%	75%	25%
0.3	5	25%	100%	0%
Total Samples	20			



Hydraulic Analysis Report

Project Data

Project Title: H-04-S

Designer:

Project Date: Friday, September 20, 2013

Project Units: U.S. Customary Units

Notes:

Wolman Count Analysis: Hydraulic Toolbox GSD

Notes:

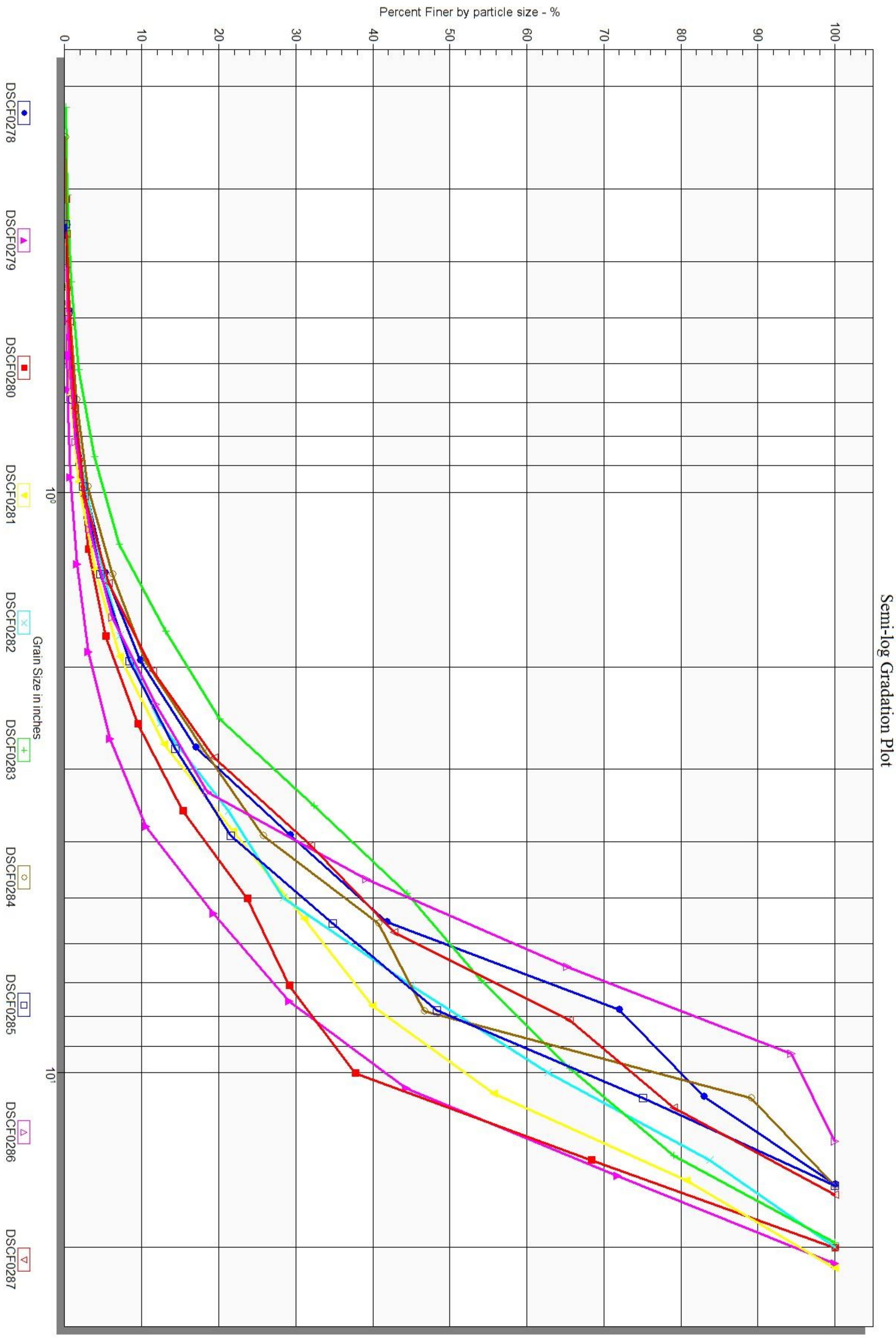

Semi-log Gradation Plot
Percent Finer by particle size - %
0
10
20
30
40
50
60
70
80
90
100
Grain Size in inches
10^0
10^1
DSCF0278
DSCF0279
DSCF0280
DSCF0281
DSCF0282
DSCF0283
DSCF0284
DSCF0285
DSCF0286
DSCF0287

Image Gradation Input Parameters

Name: DSCF0278

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0278.JPG

- Scale Line Length: 24 in
- Median Filter Radius: 2 px
- Background Subtraction Radius: 3 px
- Advanced Controls:
    - Automate Threshold Selection
    - Threshold Value: 207
    - Morphologic Iterations: 1
    - Resolution: 28 %
    - Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.060787	0	0	0.000000
0.085966	0	0	0.000000
0.121574	0	0	0.000000
0.171932	0	0	0.000000
0.243148	0	0	0.000000
0.343864	2	2	0.191022
0.486297	3	5	0.477555
0.687727	6	11	1.050621
0.972593	16	27	2.578797
1.375455	27	54	5.157593
1.945187	48	102	9.742120
2.750910	76	178	17.000955
3.890374	128	306	29.226361
5.501819	132	438	41.833811
7.780747	315	753	71.919771
11.003638	116	869	82.999045
15.561494	178	1047	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.3508 in

D15: 2.5288 in

D50: 6.1204 in

D85: 11.5401 in

D100: 15.5615 in

Image Gradation Input Parameters

Name: DSCF0279

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0279.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 200

Morphologic Iterations: 1

Resolution: 27 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.117741	0	0	0.000000
0.166511	0	0	0.000000
0.235482	0	0	0.000000
0.333022	0	0	0.000000
0.470965	1	1	0.178571
0.666045	1	2	0.357143
0.941930	2	4	0.714286
1.332090	5	9	1.607143
1.883859	8	17	3.035714
2.664179	16	33	5.892857
3.767719	26	59	10.535714
5.328359	49	108	19.285714
7.535437	55	163	29.107143
10.656718	85	248	44.285714
15.070875	154	402	71.785714
21.313435	158	560	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 2.4203 in

D15: 4.5640 in

D50: 11.5739 in

D85: 17.9946 in

D100: 21.3134 in

Image Gradation Input Parameters

Name: DSCF0280

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0280.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 207

Morphologic Iterations: 1

Resolution: 27 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.078311	0	0	0.000000
0.110749	0	0	0.000000
0.156623	0	0	0.000000
0.221498	0	0	0.000000
0.313246	1	1	0.105820
0.442996	2	3	0.317460
0.626491	5	8	0.846561
0.885992	9	17	1.798942
1.252982	12	29	3.068783
1.771985	21	50	5.291005
2.505965	40	90	9.523810
3.543969	55	145	15.343915
5.011929	79	224	23.703704
7.087938	51	275	29.100529
10.023859	81	356	37.671958
14.175877	290	646	68.359788
20.047717	299	945	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.7040 in

D15: 3.4826 in

D50: 11.6918 in

D85: 17.2640 in

D100: 20.0477 in

Image Gradation Input Parameters

Name: DSCF0281

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0281.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 207

Morphologic Iterations: 1

Resolution: 27 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.060009	0	0	0.000000
0.084866	0	0	0.000000
0.120018	0	0	0.000000
0.169732	0	0	0.000000
0.240037	0	0	0.000000
0.339463	1	1	0.123001
0.480074	1	2	0.246002
0.678927	4	6	0.738007
0.960147	9	15	1.845018
1.357854	17	32	3.936039
1.920295	26	58	7.134071
2.715707	47	105	12.915129
3.840590	73	178	21.894219
5.431414	75	253	31.119311
7.681180	72	325	39.975400
10.862829	128	453	55.719557
15.362360	203	656	80.688807
21.725657	157	813	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.5450 in

D15: 2.9769 in

D50: 9.7070 in

D85: 16.7830 in

D100: 21.7257 in

Image Gradation Input Parameters

Name: DSCF0282

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0282.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 214

Morphologic Iterations: 1

Resolution: 27 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.055265	0	0	0.000000
0.078156	0	0	0.000000
0.110529	0	0	0.000000
0.156312	0	0	0.000000
0.221059	0	0	0.000000
0.312624	1	1	0.092251
0.442117	3	4	0.369004
0.625248	6	10	0.922509
0.884234	13	23	2.121771
1.250496	23	46	4.243542
1.768469	32	78	7.195572
2.500993	57	135	12.453875
3.536938	96	231	21.309963
5.001985	76	307	28.321033
7.073875	181	488	45.018450
10.003971	192	680	62.730627
14.147751	228	908	83.763838
20.007941	176	1084	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.3832 in

D15: 2.7988 in

D50: 7.8980 in

D85: 14.5939 in

D100: 20.0079 in

Image Gradation Input Parameters

Name: DSCF0283

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0283.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 207

Morphologic Iterations: 1

Resolution: 28 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.054256	0	0	0.000000
0.076730	0	0	0.000000
0.108512	0	0	0.000000
0.153460	0	0	0.000000
0.217025	2	2	0.126823
0.306919	3	5	0.317058
0.434049	8	13	0.824350
0.613838	15	28	1.775523
0.868098	33	61	3.868104
1.227676	50	111	7.038681
1.736197	96	207	13.126189
2.455353	110	317	20.101458
3.472393	194	511	32.403297
4.910706	190	701	44.451490
6.944787	152	853	54.090044
9.821412	180	1033	65.504122
13.889574	214	1247	79.074192
19.642823	330	1577	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.9965 in

D15: 1.9294 in

D50: 6.0816 in

D85: 15.5188 in

D100: 19.6428 in

Image Gradation Input Parameters

Name: DSCF0284

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0284.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 194

Morphologic Iterations: 1

Resolution: 27 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.086426	0	0	0.000000
0.122224	0	0	0.000000
0.172851	0	0	0.000000
0.244448	1	1	0.092421
0.345702	2	3	0.277264
0.488897	4	7	0.646950
0.691405	9	16	1.478743
0.977794	16	32	2.957486
1.382809	35	67	6.192237
1.955588	46	113	10.443623
2.765619	81	194	17.929760
3.911175	85	279	25.785582
5.531237	162	441	40.757856
7.822350	64	505	46.672828
11.062474	459	964	89.094270
15.644701	118	1082	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.2335 in

D15: 2.4486 in

D50: 8.0765 in

D85: 10.7498 in

D100: 15.6447 in

Image Gradation Input Parameters

Name: DSCF0285

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0285.JPG

- Scale Line Length: 24 in
- Median Filter Radius: 2 px
- Background Subtraction Radius: 3 px
- Advanced Controls:
  - Automate Threshold Selection
  - Threshold Value: 198
  - Morphologic Iterations: 1
  - Resolution: 26 %
  - Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.061106	0	0	0.000000
0.086417	0	0	0.000000
0.122212	0	0	0.000000
0.172834	0	0	0.000000
0.244425	0	0	0.000000
0.345669	1	1	0.104167
0.488850	3	4	0.416667
0.691338	6	10	1.041667
0.977699	13	23	2.395833
1.382676	21	44	4.583333
1.955398	37	81	8.437500
2.765351	57	138	14.375000
3.910797	69	207	21.562500
5.530702	127	334	34.791667
7.821594	130	464	48.333333
11.061404	257	721	75.104167
15.643188	239	960	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.4446 in

D15: 2.8650 in

D50: 8.0233 in

D85: 12.8826 in

D100: 15.6432 in

Image Gradation Input Parameters

Name: DSCF0286

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0286.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 195

Morphologic Iterations: 1

Resolution: 27 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.072573	0	0	0.000000
0.102633	0	0	0.000000
0.145145	0	0	0.000000
0.205266	0	0	0.000000
0.290291	0	0	0.000000
0.410533	2	2	0.231750
0.580581	3	5	0.579374
0.821066	7	12	1.390498
1.161162	16	28	3.244496
1.642131	25	53	6.141367
2.322324	49	102	11.819235
3.284262	58	160	18.539977
4.644648	178	338	39.165701
6.568524	225	563	65.237543
9.289296	251	814	94.322132
13.137048	49	863	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.4526 in

D15: 2.7776 in

D50: 5.4441 in

D85: 8.4172 in

D100: 13.1370 in

Image Gradation Input Parameters

Name: DSCF0287

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0287.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 209

Morphologic Iterations: 1

Resolution: 27 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.063426	0	0	0.000000
0.089697	0	0	0.000000
0.126851	0	0	0.000000
0.179395	0	0	0.000000
0.253703	0	0	0.000000
0.358790	2	2	0.200000
0.507405	4	6	0.600000
0.717580	7	13	1.300000
1.014811	13	26	2.600000
1.435159	31	57	5.700000
2.029622	57	114	11.400000
2.870319	80	194	19.400000
4.059244	126	320	32.000000
5.740637	108	428	42.800000
8.118487	227	655	65.500000
11.481274	136	791	79.100000
16.236974	209	1000	100.000000

Two sediment samples were collected from the channel bed near Bridge H-04-Z Results of the sediment size analysis for the sediment sample collected from the channel are presented below in both tabular and graphical formats.

Table G.7.1.
Sediment sieve analysis
Sample ID: H-04-Z Plateau Creek
Sample Description: 1 of 2
Performed by: JE
Date: 9-20-2011

Sieve Size (mm)	% Finer
60	100%
44.45	100%
22.43	58%
19.1	52%
4	25%
2	18%
0.5	9%
0.25	6%
0.125	4%

Figure G.7.1.
Grain size gradation curve for the sediment sample collected from Plateau Creek in the vicinity of H-04-Z

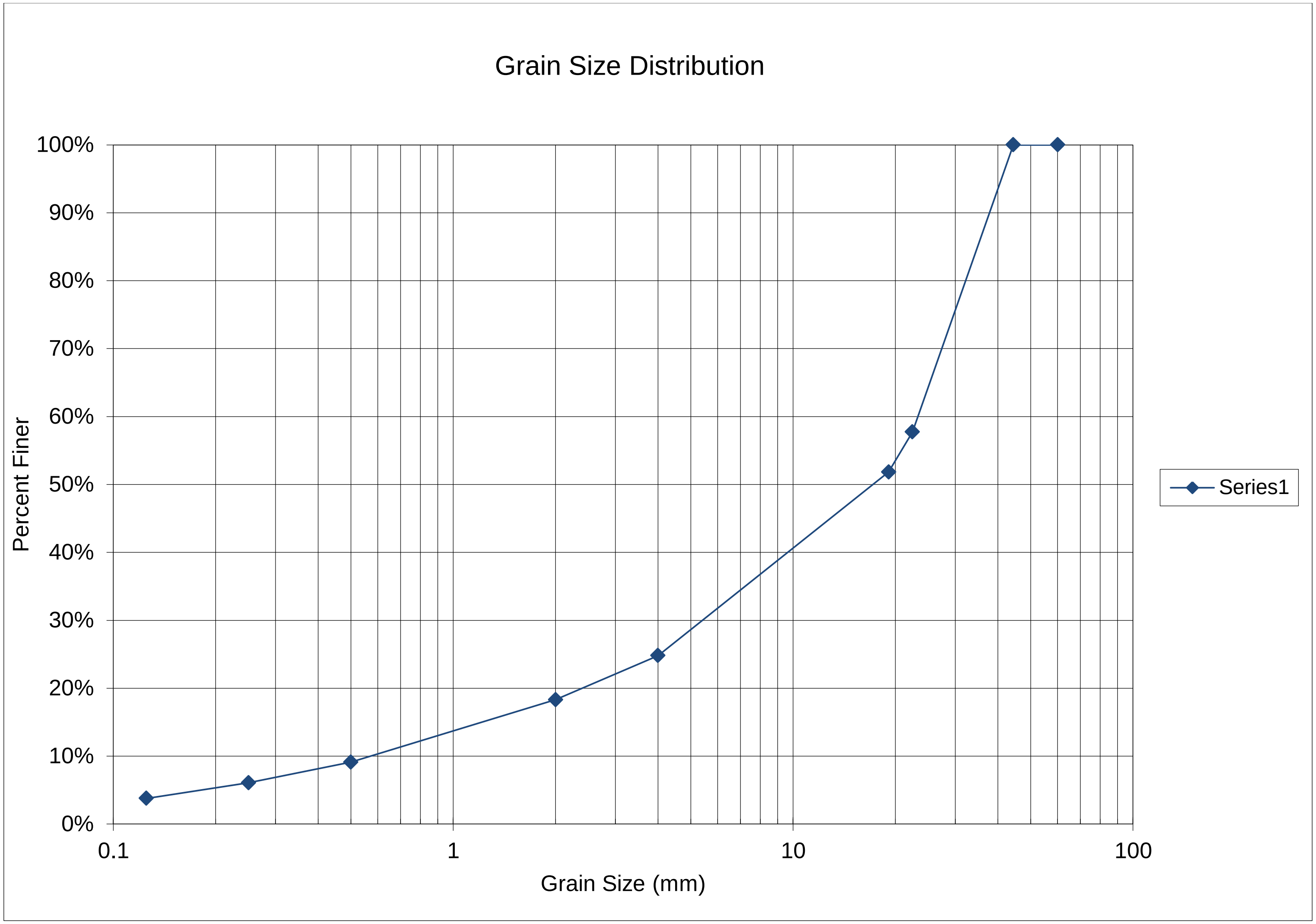


Table G.7.2.

Grain size gradation computations for the sediment sample collected from Plateau Creek in the vicinity of H-04-S

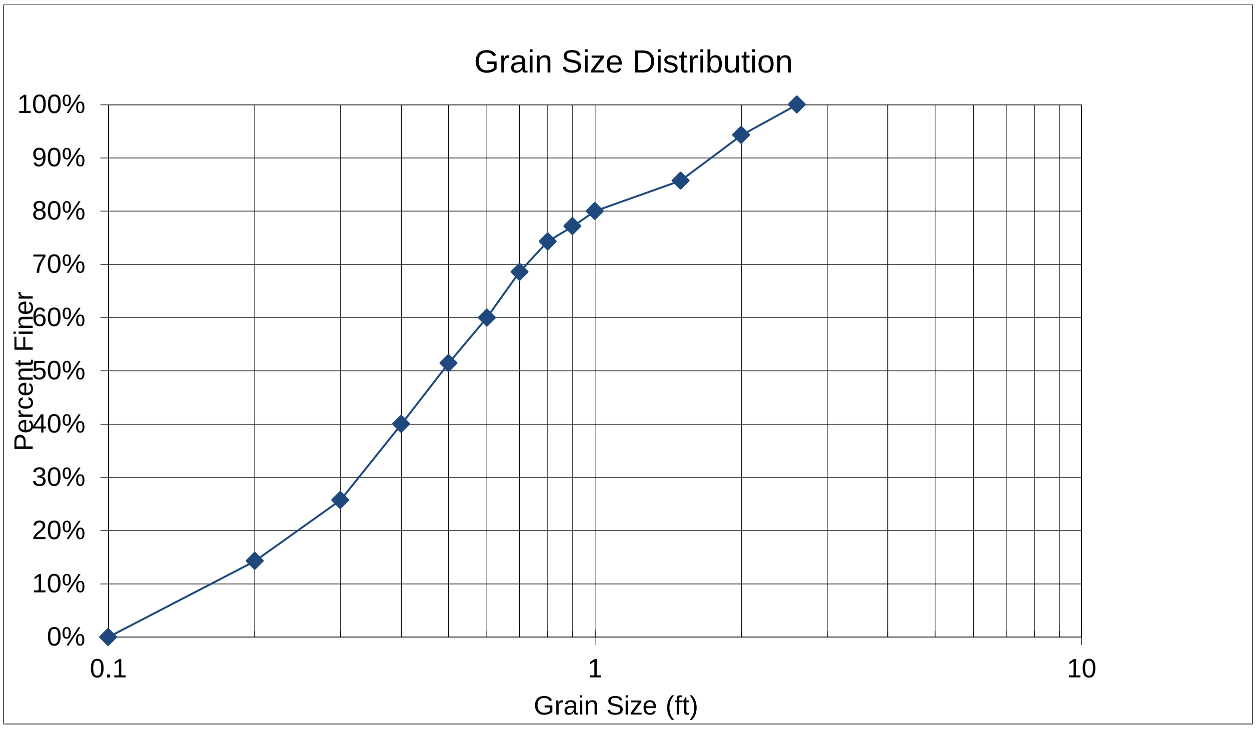
Structure # H-04-Z	**Waterbody - Plateau Creek**	**Sample # 1 of 1**	Performed by: JE Date: 9/29/2011			
Sieve Size (mm)	Weight of Sieve (g)	Weight of Sieve + Soil (g)	Weight of Soil (g)	% Retained	Cumulative % Ret.	% Finer
60	0	0	0	0%	0%	100%
44.45	0	0	0	0%	0%	100%
22.43	541.61	2024.6	1482.99	42%	42%	58%
19.1	650.33	856.47	206.14	6%	48%	52%
4	566.86	1515.3	948.44	27%	75%	25%
2	463.93	691.23	227.3	6%	82%	18%
0.5	413.67	736.26	322.59	9%	91%	9%
0.25	400.44	507.25	106.81	3%	94%	6%
0.125	382.96	462.98	80.02	2%	96%	4%
Pan	355.14	487.94	132.8	4%	100%	0%
		Total Weight of Sample	**3507.09**			

Pebble Count Grain Size Distribution

Region	Structure ID	County	Facility Carried	Mile Marker	POA Fiscal Year	Feature Intersected	D_{50} max from POA	Date
3	H-04-Z	Mesa	SH 65 ML	51.2	2012	Plateau Creek	17	8/8/2013

Sample #	A (ft)	B (ft)	C (ft)	Shape Factor	D_s (ft)	D_{avg} (ft)	Volume (ft³)
1	0.79	0.61	0.28	0.403	0.61	0.560	0.071
2	0.57	0.41	0.25	0.517	0.41	0.410	0.031
3	0.48	0.3	0.25	0.659	0.3	0.343	0.019
4	0.26	0.15	0.03	0.152	0.15	0.147	0.001
5	1.4	0.75	0.6	0.586	0.75	0.917	0.330
6	0.72	0.48	0.2	0.340	0.48	0.467	0.036
7	0.15	0.11	0.02	0.156	0.11	0.093	0.000
8	0.49	0.28	0.25	0.675	0.28	0.340	0.018
9	0.17	0.15	0.09	0.564	0.15	0.137	0.001
10	2.01	1.32	1.1	0.675	1.32	1.477	1.528
11	0.37	0.29	0.26	0.794	0.29	0.307	0.015
12	0.9	0.85	0.3	0.343	0.85	0.683	0.120
13	2.51	1.52	1.5	0.768	1.52	1.843	2.996
14	3.21	2.54	1.8	0.630	2.54	2.517	7.684
15	0.18	0.13	0.11	0.719	0.13	0.140	0.001
16	0.8	0.73	0.31	0.406	0.73	0.613	0.095
17	0.79	0.6	0.35	0.508	0.6	0.580	0.087
18	0.58	0.35	0.13	0.289	0.35	0.353	0.014
19	0.6	0.45	0.34	0.654	0.45	0.463	0.048
20	0.69	0.63	0.42	0.637	0.63	0.580	0.096
21	0.27	0.14	0.14	0.720	0.14	0.183	0.003
22	1.8	1.8	1.7	0.944	1.8	1.767	2.884
23	0.49	0.49	0.32	0.653	0.49	0.433	0.040
24	0.36	0.29	0.1	0.309	0.29	0.250	0.005
25	2	0.35	0.35	0.418	0.35	0.900	0.128
26	1.78	1.41	0.9	0.568	1.41	1.363	1.183
27	0.65	0.5	0.16	0.281	0.5	0.437	0.027
28	1.14	0.9	0.42	0.415	0.9	0.820	0.226
29	0.66	0.57	0.21	0.342	0.57	0.480	0.041
30	2.2	1.91	1.7	0.829	1.91	1.937	3.740
31	0.78	0.56	0.18	0.272	0.56	0.507	0.041
32	0.4	0.3	0.15	0.433	0.3	0.283	0.009
33	0.47	0.29	0.21	0.569	0.29	0.323	0.015
34	0.49	0.36	0.22	0.524	0.36	0.357	0.020
35	2.03	2	1.36	0.675	2	1.797	2.891

Structure # H-04-Z	Plateau Creek at SH 65			
Sieve Size (ft)	Samples Retained	% Retained	Cumulative % Ret.	% Finer
2.6	0	0%	0%	100%
2	2	6%	6%	94%
1.5	3	9%	14%	86%
1	2	6%	20%	80%
0.9	1	3%	23%	77%
0.8	1	3%	26%	74%
0.7	2	6%	31%	69%
0.6	3	9%	40%	60%
0.5	3	9%	49%	51%
0.4	4	11%	60%	40%
0.3	5	14%	74%	26%
0.2	4	11%	86%	14%
0.1	5	14%	100%	0%
Total Samples	35			



Hydraulic Analysis Report

Project Data

Project Title: H-04-Z

Designer:

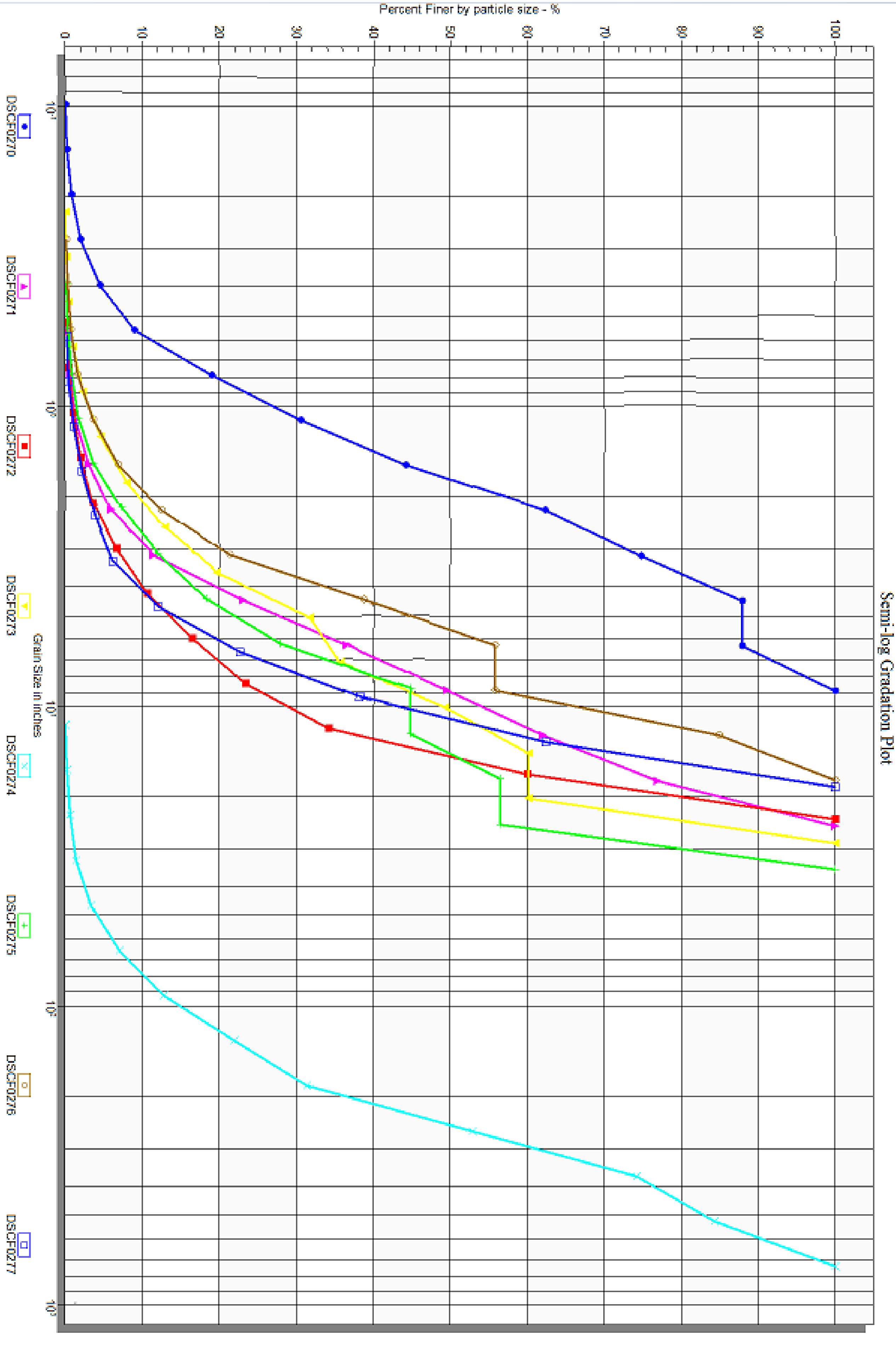
Project Date: Friday, September 20, 2013

Project Units: U.S. Customary Units

Notes:

Wolman Count Analysis: Hydraulic Toolbox GSD

Notes:



Semi-log Gradation Plot
Percent Finer by particle size - %
0
10
20
30
40
50
60
70
80
90
100
Grain Size in inches
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
DSCF0270
DSCF0271
DSCF0272
DSCF0273
DSCF0274
DSCF0275
DSCF0276
DSCF0277

Image Gradation Input Parameters Name:

DSCF0270

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0270.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 174

Morphologic Iterations: 1

Resolution: 32 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.034800	0	0	0.000000
0.049214	0	0	0.000000
0.069599	0	0	0.000000
0.098428	1	1	0.039032
0.139199	6	7	0.273224
0.196857	14	21	0.819672
0.278398	30	51	1.990632
0.393714	64	115	4.488681
0.556795	116	231	9.016393
0.787428	257	488	19.047619
1.113591	295	783	30.562061
1.574855	351	1134	44.262295
2.227182	462	1596	62.295082
3.149711	319	1915	74.746292
4.454363	337	2252	87.900078
6.299421	0	2252	87.900078
8.908727	310	2562	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.4121 in

D15: 0.6944 in

D50: 1.7824 in

D85: 4.1667 in

D100: 8.9087 in

Image Gradation Input Parameters

Name: DSCF0271

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0271.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 196

Morphologic Iterations: 1

Resolution: 27 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.098021	0	0	0.000000
0.138623	0	0	0.000000
0.196042	0	0	0.000000
0.277245	0	0	0.000000
0.392084	0	0	0.000000
0.554490	1	1	0.163666
0.784168	3	4	0.654664
1.108981	4	8	1.309329
1.568336	11	19	3.109656
2.217961	17	36	5.891980
3.136671	34	70	11.456628
4.435923	71	141	23.076923
6.273342	82	223	36.497545
8.871846	80	303	49.590835
12.546685	76	379	62.029460
17.743692	91	470	76.923077
25.093370	141	611	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 2.0097 in

D15: 3.5329 in

D50: 8.9927 in

D85: 20.3161 in

D100: 25.0934 in

Image Gradation Input Parameters

Name: DSCF0272

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0272.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 207

Morphologic Iterations: 1

Resolution: 28 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.065794	0	0	0.000000
0.093047	0	0	0.000000
0.131589	0	0	0.000000
0.186095	0	0	0.000000
0.263178	0	0	0.000000
0.372190	0	0	0.000000
0.526356	1	1	0.196850
0.744380	1	2	0.393701
1.052712	3	5	0.984252
1.488759	5	10	1.968504
2.105424	8	18	3.543307
2.977519	16	34	6.692913
4.210847	20	54	10.629921
5.955037	30	84	16.535433
8.421694	35	119	23.425197
11.910074	55	174	34.251969
16.843389	131	305	60.039370
23.820149	203	508	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 2.5088 in

D15: 5.5015 in

D50: 14.9228 in

D85: 21.2013 in

D100: 23.8201 in

Image Gradation Input Parameters

Name: DSCF0273

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0273.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 212

Morphologic Iterations: 1

Resolution: 27 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.056001	0	0	0.000000
0.079198	0	0	0.000000
0.112002	0	0	0.000000
0.158395	0	0	0.000000
0.224005	1	1	0.079872
0.316790	1	2	0.159744
0.448009	4	6	0.479233
0.633581	7	13	1.038339
0.896018	16	29	2.316294
1.267161	29	58	4.632588
1.792037	42	100	7.987220
2.534322	62	162	12.939297
3.584073	85	247	19.728435
5.068645	151	398	31.789137
7.168146	48	446	35.623003
10.137290	172	618	49.361022
14.336293	135	753	60.143770
20.274580	0	753	60.143770
28.672586	499	1252	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.3246 in

D15: 2.8530 in

D50: 10.3861 in

D85: 25.5120 in

D100: 28.6726 in

Image Gradation Input Parameters

Name: DSCF0274

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0274.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 187

Morphologic Iterations: 1

Resolution: 27 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
4.085502	0	0	0.000000
5.777773	0	0	0.000000
8.171005	0	0	0.000000
11.555545	1	1	0.073910
16.342009	2	3	0.221729
23.111091	5	8	0.591279
32.684018	11	19	1.404287
46.222182	27	46	3.399852
65.368036	49	95	7.021434
92.444363	78	173	12.786401
130.736072	124	297	21.951220
184.888726	127	424	31.337768
261.472144	291	715	52.845528
369.777453	289	1004	74.205469
522.944289	137	1141	84.331116
739.554906	212	1353	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 54.6815 in

D15: 101.6930 in

D50: 251.3400 in

D85: 532.1911 in

D100: 739.5549 in

Image Gradation Input Parameters

Name: DSCF0275

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0275.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 211

Morphologic Iterations: 1

Resolution: 28 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.068442	0	0	0.000000
0.096792	0	0	0.000000
0.136884	0	0	0.000000
0.193583	0	0	0.000000
0.273768	0	0	0.000000
0.387167	1	1	0.116279
0.547537	2	3	0.348837
0.774334	4	7	0.813953
1.095073	8	15	1.744186
1.548667	16	31	3.604651
2.190146	31	62	7.209302
3.097334	41	103	11.976744
4.380292	55	158	18.372093
6.194669	83	241	28.023256
8.760585	144	385	44.767442
12.389338	0	385	44.767442
17.521169	101	486	56.511628
24.778675	0	486	56.511628
35.042338	374	860	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.7970 in

D15: 3.7038 in

D50: 14.6758 in

D85: 31.5022 in

D100: 35.0423 in

Image Gradation Input Parameters

Name: DSCF0276

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0276.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 221

Morphologic Iterations: 1

Resolution: 28 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.069258	0	0	0.000000
0.097945	0	0	0.000000
0.138516	0	0	0.000000
0.195891	0	0	0.000000
0.277031	1	1	0.106270
0.391781	2	3	0.318810
0.554063	4	7	0.743889
0.783563	8	15	1.594049
1.108125	19	34	3.613177
1.567126	31	65	6.907545
2.216251	53	118	12.539851
3.134252	82	200	21.253985
4.432501	164	364	38.682253
6.268503	161	525	55.791711
8.865003	0	525	55.791711
12.537007	274	799	84.909671
17.730005	142	941	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.3013 in

D15: 2.4754 in

D50: 5.6470 in

D85: 12.5681 in

D100: 17.7300 in

Image Gradation Input Parameters

Name: DSCF0277

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0277.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 192

Morphologic Iterations: 1

Resolution: 28 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.072794	0	0	0.000000
0.102946	0	0	0.000000
0.145587	0	0	0.000000
0.205892	0	0	0.000000
0.291175	0	0	0.000000
0.411783	0	0	0.000000
0.582350	1	1	0.214592
0.823567	1	2	0.429185
1.164700	3	5	1.072961
1.647134	5	10	2.145923
2.329399	8	18	3.862661
3.294268	11	29	6.223176
4.658798	27	56	12.017167
6.588536	50	106	22.746781
9.317597	72	178	38.197425
13.177071	113	291	62.446352
18.635193	175	466	100.000000

Two sediment samples were collected from the channel bed near Bridge H-07-H. Results of the sediment size analysis for the sediment sample collected from the channel are presented below in both tabular and graphical formats.

Figure G.8.1.
Photo of sediment sample from the H-07-H site

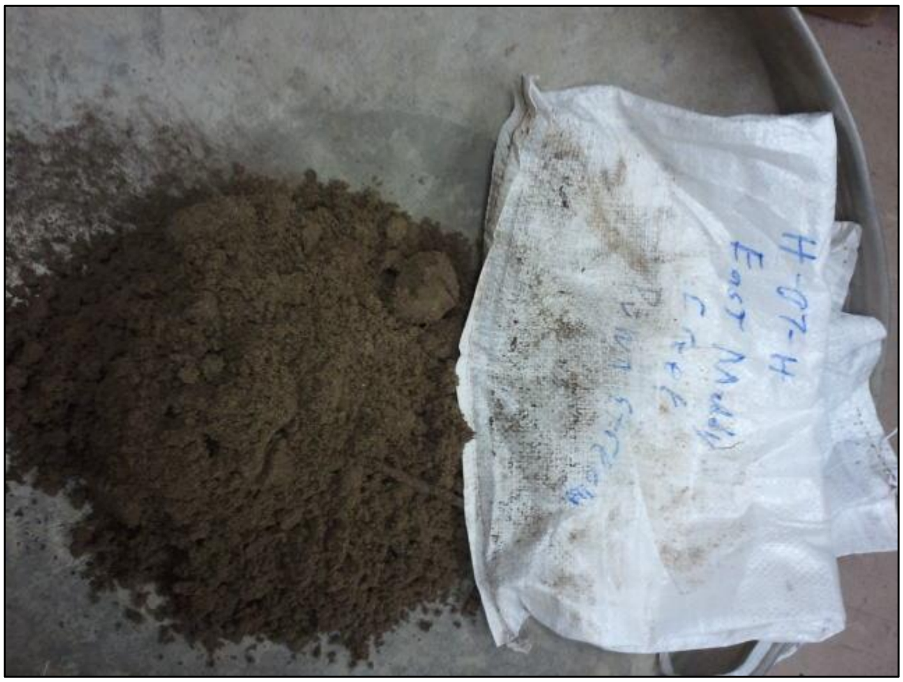


Table G.8.1.
Sediment sieve analysis
Sample ID: H-07-H East Muddy Creek
Sample Description: 1 of 2
Performed by: JE
Date: 8-15-2012

Sieve Size (mm)	% Finer
44.45	100%
2	97%
1	97%
0.5	79%
0.25	14%
0.125	4%
0.063	1%
0.075	1%

Figure G.8.2.

Grain size gradation curve for the sediment sample collected from East Muddy Creek in the vicinity of H-07-H

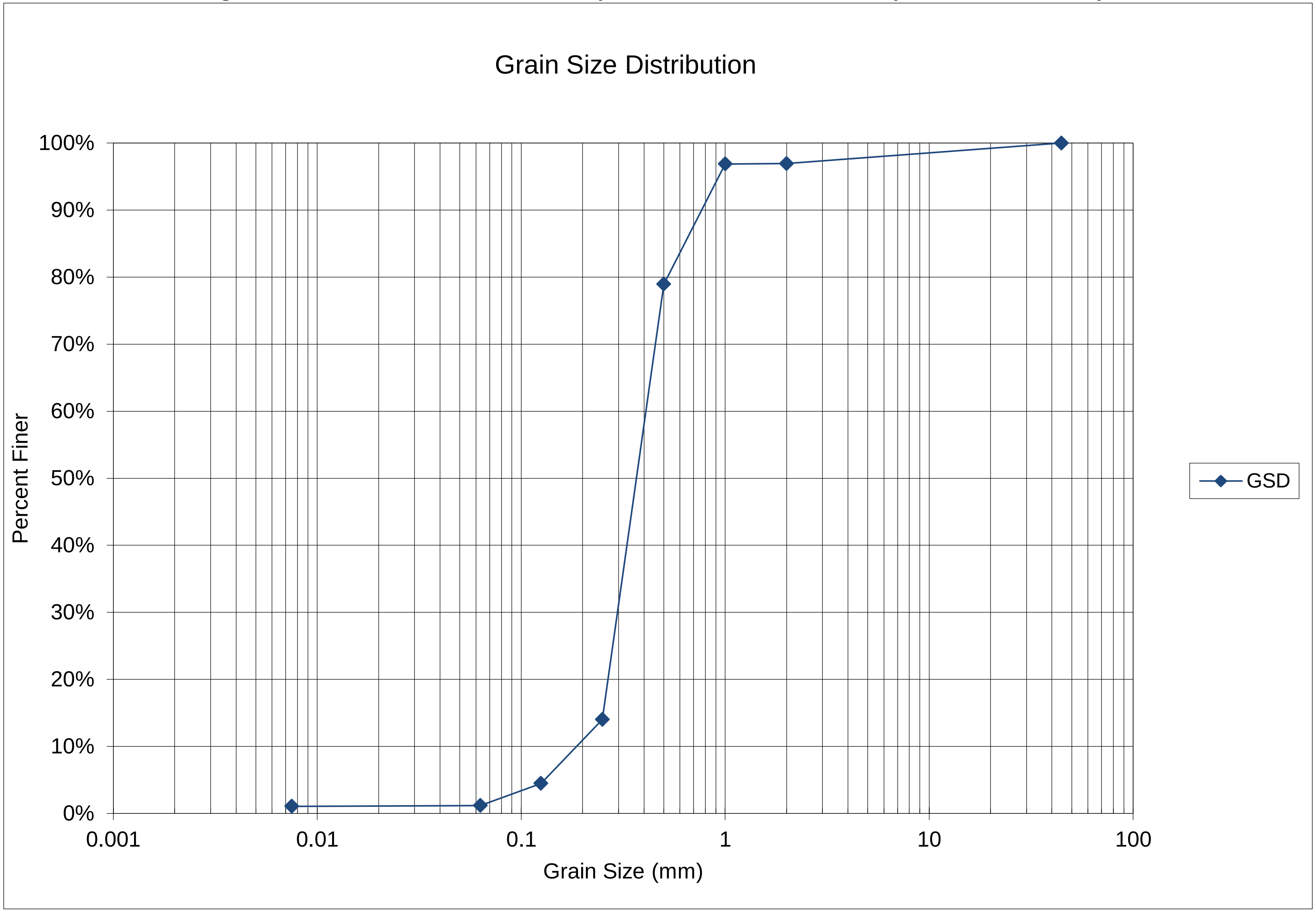


Table G.8.2.

Grain size gradation computations for the sediment sample collected from East Muddy Creek in the vicinity of H-07-H

Structure # H-07-H	**Waterbody - E. Muddy Creek**	**Sample # 1 of 2**	Performed by: JE			
			Date: 9/12/2012			
Sieve Size (mm)	Weight of Sieve (g)	Weight of Sieve + Soil (g)	Weight of Soil (g)	% Retained	Cumulative % Ret.	% Finer
44.45	0	0	0	0%	0%	100%
2	479.61	561.3	81.69	3%	3%	97%
1	500.31	501.61	1.3	0%	3%	97%
0.5	441.02	919.69	478.67	18%	21%	79%
0.25	392.91	2125.1	1732.19	65%	86%	14%
0.125	377.3	631.36	254.06	10%	96%	4%
0.063	359.61	447.54	87.93	3%	99%	1%
0.0075	321.01	324.23	3.22	0%	99%	1%
Pan	371.72	399.98	28.26	1%	100%	0%
		Total Weight of Sample	**2667.32**			

Figure G.8.3.
Photo of sediment sample from the H-07-H site

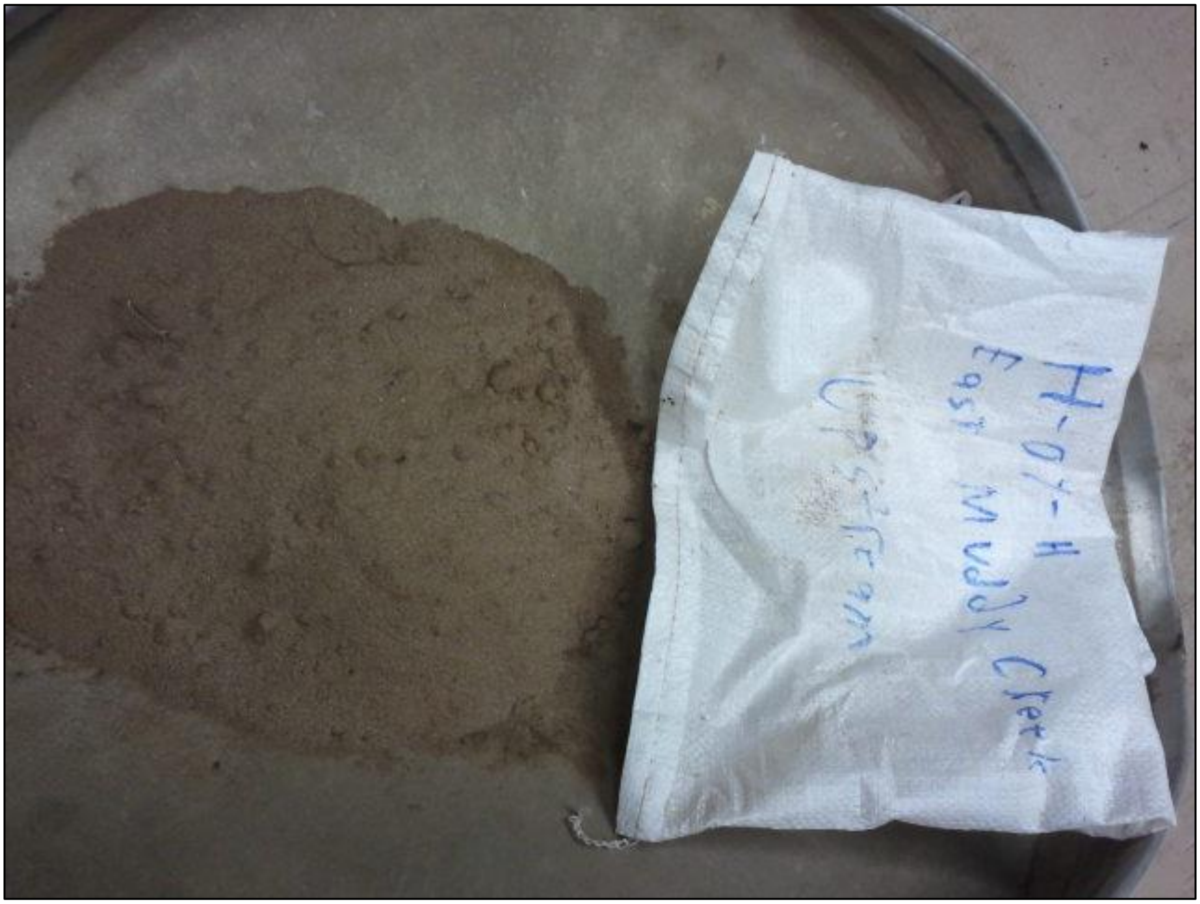


Table G.8.3.
Sediment sieve analysis
Sample ID: H-07-H East Muddy Creek
Sample Description: 2 of 2
Performed by: JE
Date: 8-15-2012

Sieve Size (mm)	% Finer
44.45	100%
4	90%
2	84%
1	79%
0.5	73%
0.25	18%
0.125	8%
0.0075	3%

Figure G.8.4.

Grain size gradation curve for the sediment sample collected from East Muddy Creek in the vicinity of H-07-H

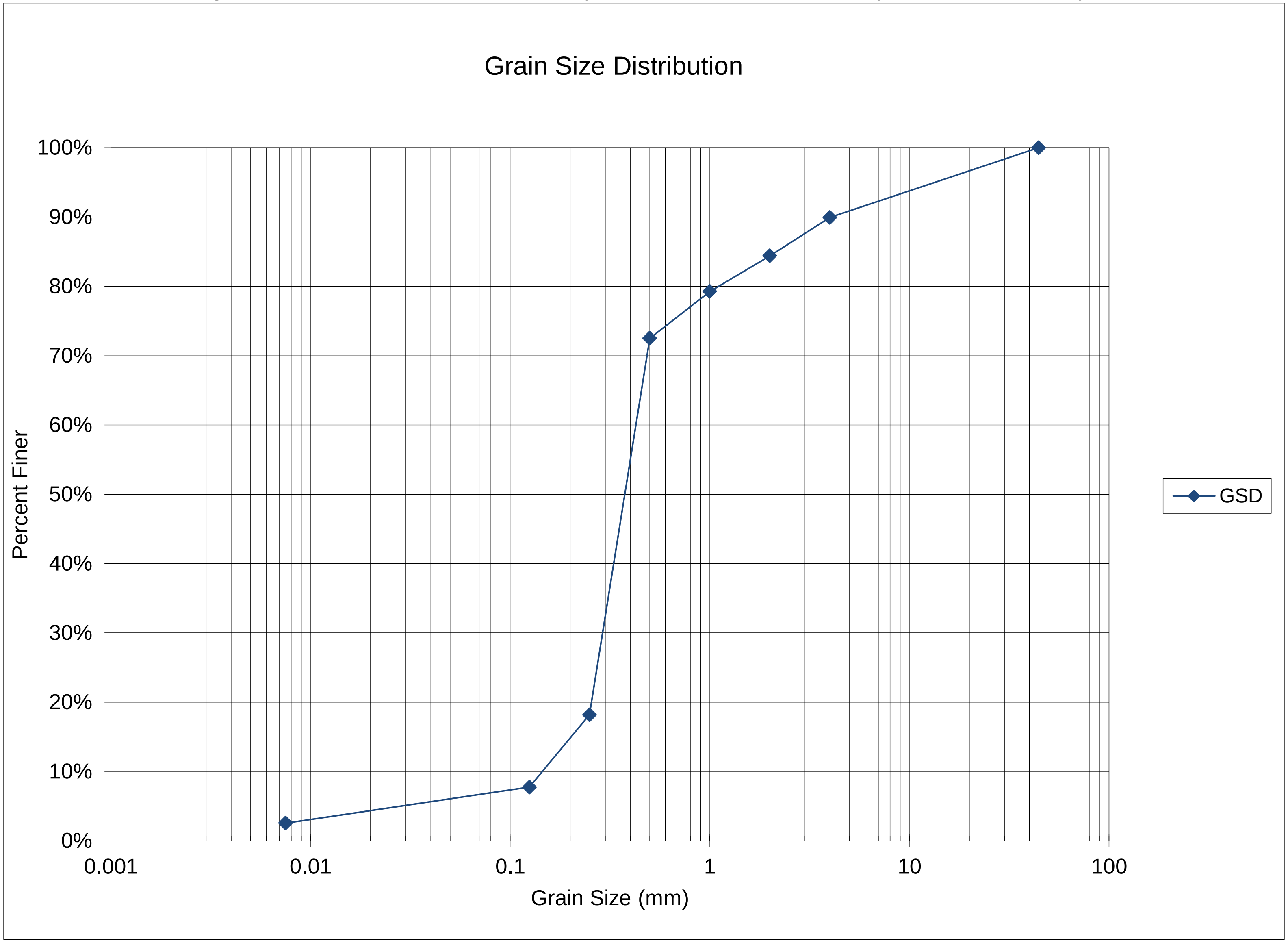


Table G.8.4.

Grain size gradation computations for the sediment sample collected from East Muddy Creek in the vicinity of H-07-H

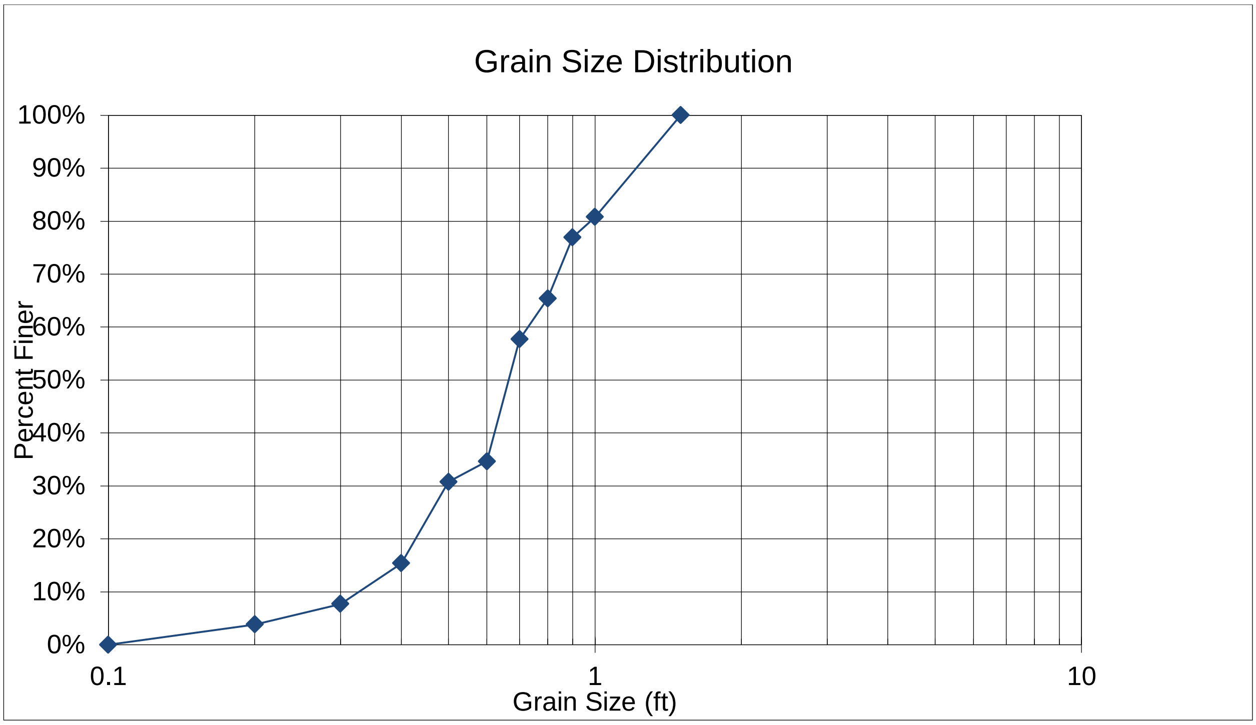
Structure # H-07-H	**Waterbody - E. Muddy Creek**	**Sample # 2 of 2**	Performed by: JE Date: 9/12/2012			
Sieve Size (mm)	Weight of Sieve (g)	Weight of Sieve + Soil (g)	Weight of Soil (g)	% Retained	Cumulative % Ret.	% Finer
44.45	0	0	0	0%	0%	100%
4	491.59	675.07	183.48	10%	10%	90%
2	479.61	580.34	100.73	6%	16%	84%
1	500.31	594.19	93.88	5%	21%	79%
0.5	441.02	564.51	123.49	7%	27%	73%
0.25	392.91	1383.9	990.99	54%	82%	18%
0.125	377.3	567.68	190.38	10%	92%	8%
0.0075	321.01	415.88	94.87	5%	97%	3%
Pan	371.72	418.09	46.37	3%	100%	0%
		Total Weight of Sample	**1824.19**			

Pebble Count Grain Size Distribution

Region	Structure ID	County	Facility Carried	Mile Marker	POA Fiscal Year	Feature Intersected
3	H-07-H	Gunnison	SH 133 ML	36.1	2013	East Muddy Creek

Sample #	A (ft)	B (ft)	C (ft)	Shape Factor	D_s (ft)	D_{avg} (ft)	Volume (ft^3)
1	1.04	1	0.32	0.314	1	0.787	0.174
2	1.4	1.22	0.55	0.421	1.22	1.057	0.492
3	0.7	0.6	0.38	0.586	0.6	0.560	0.084
4	0.8	0.42	0.2	0.345	0.42	0.473	0.035
5	1	0.85	0.55	0.597	0.85	0.800	0.245
6	0.3	0.25	0.2	0.730	0.25	0.250	0.008
7	0.6	0.4	0.33	0.674	0.4	0.443	0.041
8	0.78	0.4	0.35	0.627	0.4	0.510	0.057
9	1.35	1.2	0.8	0.629	1.2	1.117	0.679
10	0.7	0.55	0.18	0.290	0.55	0.477	0.036
11	1.3	0.8	0.45	0.441	0.8	0.850	0.245
12	0.67	0.6	0.3	0.473	0.6	0.523	0.063
13	0.86	0.65	0.3	0.401	0.65	0.603	0.088
14	1.05	0.9	0.55	0.566	0.9	0.833	0.272
15	0.42	0.38	0.33	0.826	0.38	0.377	0.028
16	2	1.3	1	0.620	1.3	1.433	1.361
17	1	0.65	0.4	0.496	0.65	0.683	0.136
18	0.85	0.1	0.5	1.715	0.1	0.483	0.022
19	0.75	0.6	0.2	0.298	0.6	0.517	0.047
20	0.55	0.34	0.2	0.462	0.34	0.363	0.020
21	0.55	0.45	0.25	0.503	0.45	0.417	0.032
22	1	1	0.6	0.600	1	0.867	0.314
23	0.9	0.8	0.35	0.412	0.8	0.683	0.132
24	1.15	0.78	0.42	0.443	0.78	0.783	0.197
25	0.82	0.75	0.7	0.893	0.75	0.757	0.225
26	0.25	0.15	0.1	0.516	0.15	0.167	0.002

Structure # H-07-H	East Muddy Creek at SH 133			
Sieve Size (ft)	Samples Retained	% Retained	Cumulative % Ret.	% Finer
1.5	0	0%	0%	100%
1	5	19%	19%	81%
0.9	1	4%	23%	77%
0.8	3	12%	35%	65%
0.7	2	8%	42%	58%
0.6	6	23%	65%	35%
0.5	1	4%	69%	31%
0.4	4	15%	85%	15%
0.3	2	8%	92%	8%
0.2	1	4%	96%	4%
0.1	1	4%	100%	0%
Total Samples	26			



Hydraulic Analysis Report

Project Data

Project Title: H-07-H

Designer:

Project Date: Friday, September 20, 2013

Project Units: U.S. Customary Units

Notes:

Wolman Count Analysis: Hydraulic Toolbox GSD

Notes:

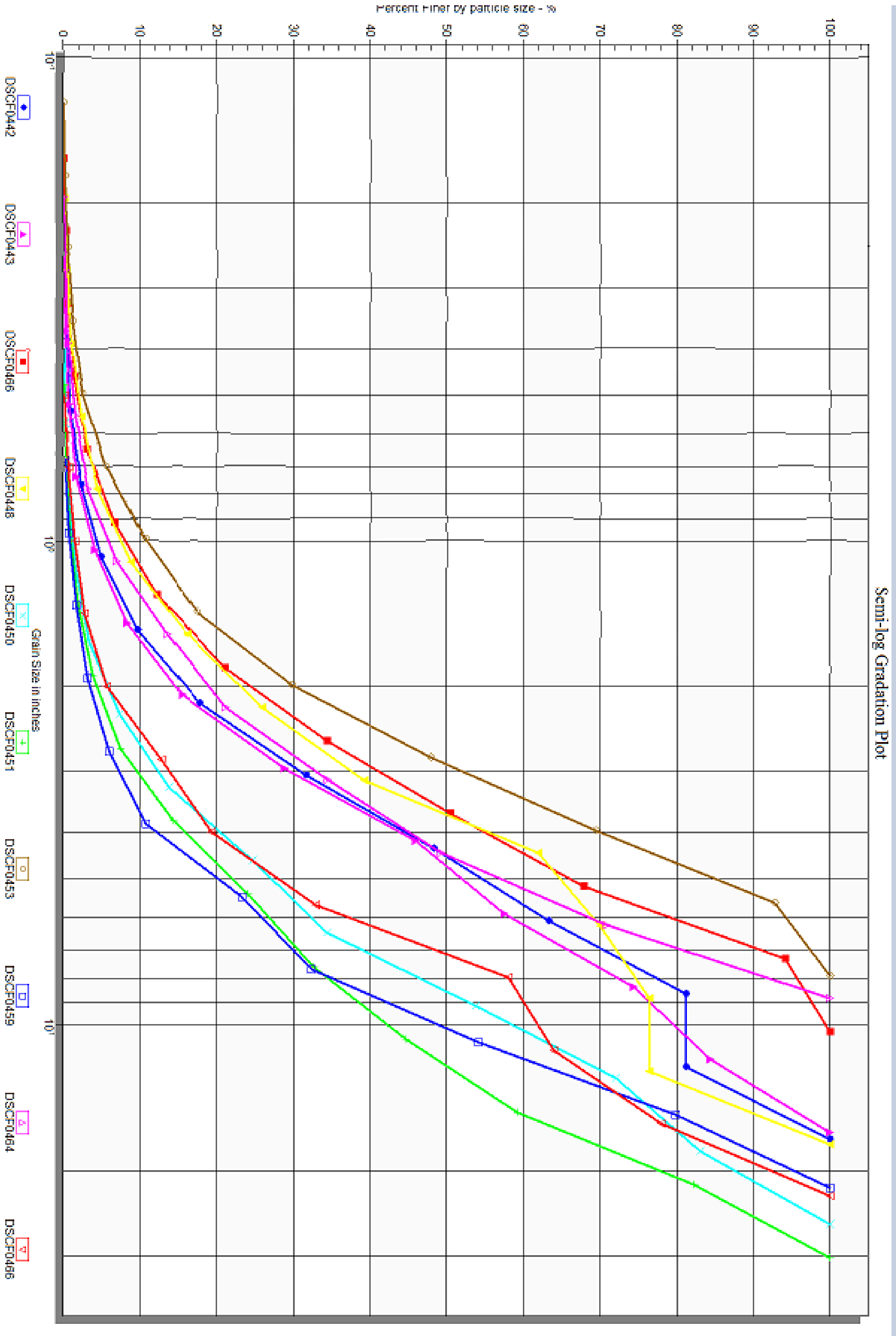

Semi-log Gradation Plot
Percent Finer by particle size - %
0
10
20
30
40
50
60
70
80
90
100
Grain Size in inches
DSCF0442
DSCF0443
DSCF0466
DSCF0448
DSCF0450
DSCF0451
DSCF0453
DSCF0459
DSCF0464
DSCF0466

Image Gradation Input Parameters

Name: DSCF0442

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0442.JPG

Scale Line Length: 48 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 207

Morphologic Iterations: 1

Resolution: 30 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.067450	0	0	0.000000
0.095389	0	0	0.000000
0.134900	0	0	0.000000
0.190777	0	0	0.000000
0.269800	2	2	0.114025
0.381554	5	7	0.399088
0.539599	9	16	0.912201
0.763108	24	40	2.280502
1.079198	47	87	4.960091
1.526217	82	169	9.635120
2.158396	143	312	17.787913
3.052434	243	555	31.641961
4.316793	293	848	48.346636
6.104867	263	1111	63.340935
8.633586	314	1425	81.242873
12.209734	0	1425	81.242873
17.267172	329	1754	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.0830 in

D15: 1.9422 in

D50: 4.5140 in

D85: 13.2228 in

D100: 17.2672 in

Image Gradation Input Parameters

Name: DSCF0443

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0443.JPG

Scale Line Length: 48 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 206

Morphologic Iterations: 1

Resolution: 30 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.065222	0	0	0.000000
0.092238	0	0	0.000000
0.130444	0	0	0.000000
0.184475	0	0	0.000000
0.260887	1	1	0.058005
0.368950	4	5	0.290023
0.521774	8	13	0.754060
0.737900	17	30	1.740139
1.043549	42	72	4.176334
1.475800	72	144	8.352668
2.087097	123	267	15.487239
2.951601	230	497	28.828306
4.174194	296	793	45.997680
5.903202	199	992	57.540603
8.348388	291	1283	74.419954
11.806404	173	1456	84.454756
16.696777	268	1724	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.1288 in

D15: 2.0453 in

D50: 4.7737 in

D85: 11.9779 in

D100: 16.6968 in

Image Gradation Input Parameters

Name: DSCF0466

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0446.JPG

Scale Line Length: 48 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 198

Morphologic Iterations: 1

Resolution: 46 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.040421	0	0	0.000000
0.057164	0	0	0.000000
0.080843	0	0	0.000000
0.114329	0	0	0.000000
0.161685	1	1	0.051787
0.228657	3	4	0.207147
0.323370	8	12	0.621440
0.457315	16	28	1.450026
0.646741	32	60	3.107198
0.914630	69	129	6.680476
1.293482	107	236	12.221647
1.829259	170	406	21.025375
2.586964	259	665	34.438115
3.658519	309	974	50.440186
5.173927	336	1310	67.840497
7.317038	508	1818	94.148110
10.347854	113	1931	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.7886 in

D15: 1.4626 in

D50: 3.6290 in

D85: 6.5718 in

D100: 10.3479 in

Image Gradation Input Parameters

Name: DSCF0448

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0448.JPG

- Scale Line Length: 48 in
- Median Filter Radius: 2 px
- Background Subtraction Radius: 3 px
- Advanced Controls:
  - Automate Threshold Selection
  - Threshold Value: 185
  - Morphologic Iterations: 1
  - Resolution: 34 %
  - Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.048777	0	0	0.000000
0.068982	0	0	0.000000
0.097555	0	0	0.000000
0.137963	0	0	0.000000
0.195109	3	3	0.167504
0.275926	5	8	0.446678
0.390218	11	19	1.060860
0.551852	23	42	2.345059
0.780437	37	79	4.410944
1.103705	78	157	8.766052
1.560874	132	289	16.136237
2.207409	175	464	25.907314
3.121748	239	703	39.251815
4.414818	406	1109	61.920715
6.243496	145	1254	70.016750
8.829637	115	1369	76.437744
12.486992	0	1369	76.437744
17.659273	422	1791	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.8242 in

D15: 1.4904 in

D50: 3.7348 in

D85: 14.3665 in

D100: 17.6593 in

Image Gradation Input Parameters

Name: DSCF0450

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0450.JPG

- Scale Line Length: 48 in
- Median Filter Radius: 2 px
- Background Subtraction Radius: 3 px
- Advanced Controls:
  - Automate Threshold Selection
  - Threshold Value: 211
  - Morphologic Iterations: 1
  - Resolution: 28 %
  - Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.100872	0	0	0.000000
0.142655	0	0	0.000000
0.201745	0	0	0.000000
0.285310	0	0	0.000000
0.403490	1	1	0.115340
0.570621	1	2	0.230681
0.806980	4	6	0.692042
1.141242	8	14	1.614764
1.613960	15	29	3.344867
2.282484	35	64	7.381776
3.227920	55	119	13.725490
4.564968	95	214	24.682814
6.455839	84	298	34.371396
9.129935	168	466	53.748558
12.911678	159	625	72.087659
18.259870	95	720	83.044983
25.823356	147	867	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.8881 in

D15: 3.3834 in

D50: 8.6126 in

D85: 19.1320 in

D100: 25.8234 in

Image Gradation Input Parameters

Name: DSCF0451

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0451.JPG

Scale Line Length: 48 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 208

Morphologic Iterations: 1

Resolution: 29 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.118561	0	0	0.000000
0.167671	0	0	0.000000
0.237122	0	0	0.000000
0.335341	0	0	0.000000
0.474244	1	1	0.105042
0.670683	2	3	0.315126
0.948488	5	8	0.840336
1.341365	10	18	1.890756
1.896977	19	37	3.886555
2.682730	34	71	7.457983
3.793953	66	137	14.390756
5.365460	92	229	24.054622
7.587906	82	311	32.668067
10.730920	115	426	44.747899
15.175813	138	564	59.243697
21.461841	219	783	82.247899
30.351626	169	952	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 2.1419 in

D15: 3.8930 in

D50: 12.3414 in

D85: 22.8400 in

D100: 30.3516 in

Image Gradation Input Parameters

Name: DSCF0453

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0453.JPG

Scale Line Length: 48 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 194

Morphologic Iterations: 1

Resolution: 55 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.043805	0	0	0.000000
0.061950	0	0	0.000000
0.087610	0	0	0.000000
0.123899	1	1	0.073368
0.175220	2	3	0.220103
0.247799	4	7	0.513573
0.350440	9	16	1.173881
0.495597	18	34	2.494497
0.700880	41	75	5.502568
0.991194	70	145	10.638298
1.401761	92	237	17.388114
1.982389	169	406	29.787234
2.803521	247	653	47.909024
3.964778	294	947	69.479090
5.607042	318	1265	92.809978
7.929555	98	1363	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.6666 in

D15: 1.2565 in

D50: 2.9161 in

D85: 5.0573 in

D100: 7.9296 in

Image Gradation Input Parameters

Name: DSCF0459

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0459.JPG

Scale Line Length: 48 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 196

Morphologic Iterations: 1

Resolution: 29 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.084921	0	0	0.000000
0.120096	0	0	0.000000
0.169842	0	0	0.000000
0.240193	0	0	0.000000
0.339684	0	0	0.000000
0.480385	0	0	0.000000
0.679368	1	1	0.239808
0.960771	2	3	0.719424
1.358735	4	7	1.678657
1.921542	6	13	3.117506
2.717470	12	25	5.995204
3.843083	20	45	10.791367
5.434940	52	97	23.261391
7.686166	38	135	32.374101
10.869880	91	226	54.196643
15.372332	107	333	79.856115
21.739761	84	417	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 2.4422 in

D15: 4.3803 in

D50: 10.2576 in

D85: 16.9983 in

D100: 21.7398 in

Image Gradation Input Parameters

Name: DSCF0464

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0464.JPG

Scale Line Length: 48 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 205

Morphologic Iterations: 1

Resolution: 27 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.048719	0	0	0.000000
0.068900	0	0	0.000000
0.097439	0	0	0.000000
0.137799	0	0	0.000000
0.194878	1	1	0.083403
0.275599	2	3	0.250209
0.389756	5	8	0.667223
0.551198	11	19	1.584654
0.779511	19	38	3.169308
1.102395	46	84	7.005838
1.559023	79	163	13.594662
2.204791	91	254	21.184320
3.118045	160	414	34.528774
4.409582	177	591	49.291076
6.236090	259	850	70.892410
8.819164	349	1199	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.9336 in

D15: 1.6786 in

D50: 4.4695 in

D85: 7.4880 in

D100: 8.8192 in

Image Gradation Input Parameters

Name: DSCF0466

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0466.JPG

Scale Line Length: 48 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 201

Morphologic Iterations: 1

Resolution: 28 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.088332	0	0	0.000000
0.124920	0	0	0.000000
0.176663	0	0	0.000000
0.249840	0	0	0.000000
0.353326	0	0	0.000000
0.499679	1	1	0.163934
0.706653	3	4	0.655738
0.999358	5	9	1.475410
1.413306	8	17	2.786885
1.998716	18	35	5.737705
2.826611	43	78	12.786885
3.997432	40	118	19.344262
5.653223	83	201	32.950820
7.994864	153	354	58.032787
11.306445	36	390	63.934426
15.989729	86	476	78.032787
22.612891	134	610	100.000000

Two sediment samples were collected from the channel bed near Bridge H-11-AA Results of the sediment size analysis for the sediment sample collected from the channel are presented below in both tabular and graphical formats.

Figure G.9.1.
Photo of sediment sample from the H-11-AA site

Table G.9.1.
Sediment sieve analysis
Sample ID: H-11-AA Arkansas River
Sample Description: 1 of 2
Performed by: JE
Date: 9-20-2011

Sieve Size (mm)	% Finer
60	100%
44.45	100%
31.75	74%
19	57%
4	28%
2	21%
0.5	3%
0.25	0%
0.074	0%

Figure G.9.2.

Grain size gradation curve for the sediment sample collected from the Arkansas River in the vicinity of H-11-AA

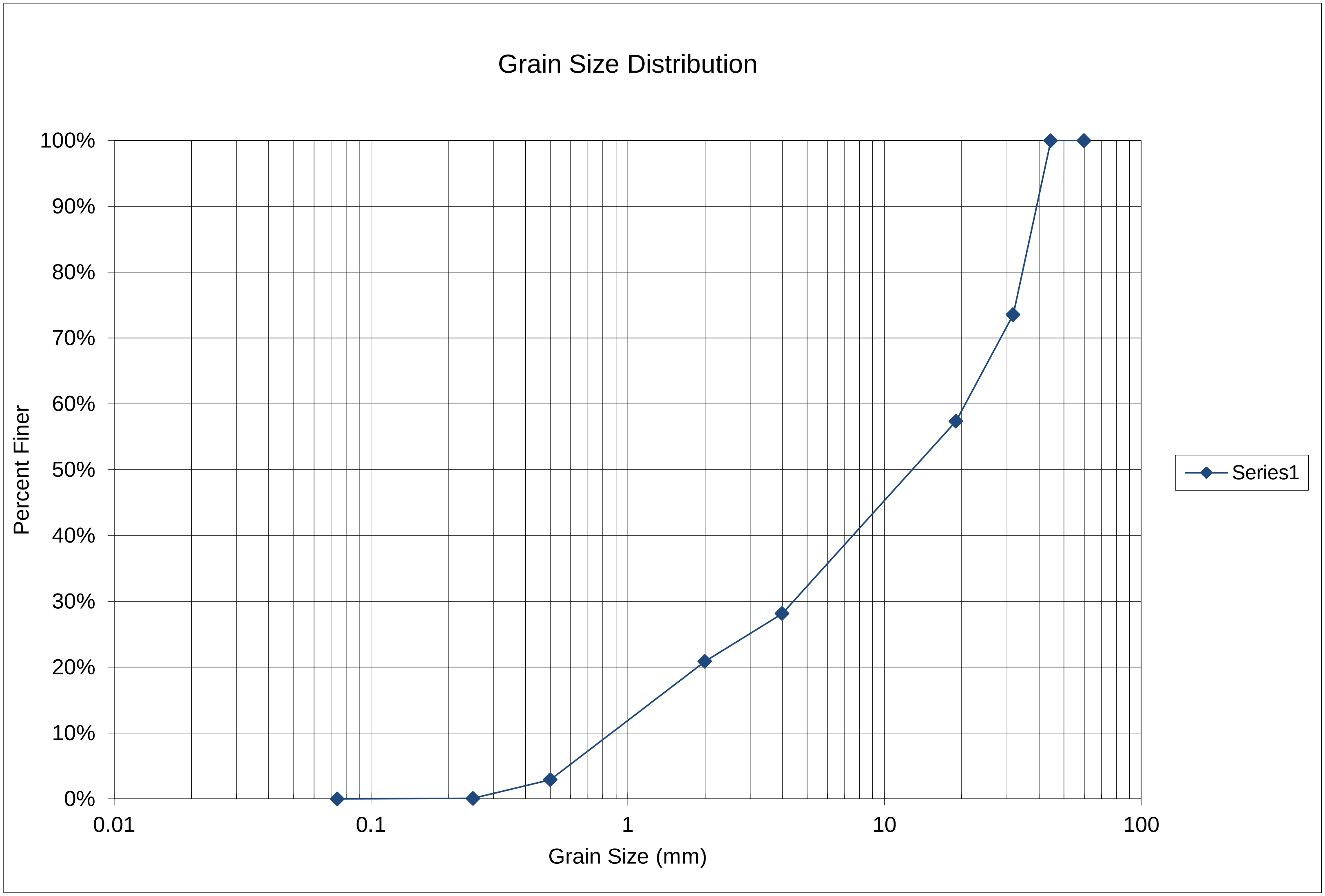


Table G.9.2.

Grain size gradation computations for the sediment sample collected from the Arkansas River in the vicinity of H-11-AA

Structure # H-11-AA	**Waterbody - Arkansas River**	**Sample # 1 of 2**	Performed by: BS and JE Date: 9/14/2011			
Sieve Size (mm)	Weight of Sieve (g)	Weight of Sieve + Soil (g)	Weight of Soil (g)	% Retained	Cumulative % Ret.	% Finer
60	0	0	0	0%	0%	100%
44.45	0	0	0	0%	0%	100%
31.75	550.22	1796	1245.78	26%	26%	74%
19	651.7	1414.3	762.6	16%	43%	57%
4	520.5	1897.5	1377	29%	72%	28%
2	479.5	821.5	342	7%	79%	21%
0.5	412.95	1260.8	847.85	18%	97%	3%
0.25	389.74	523.3	133.56	3%	100%	0%
0.074	375.12	378.4	3.28	0%	100%	0%
Pan	371.99	372.1	0.11	0%	100%	0%
		Total Weight of Sample	**4712.18**			

Figure G.9.3.
Photo of sediment sample from the H-11-AA site

Table G.9.3.
Sediment sieve analysis
Sample ID: H-11-AA Arkansas River
Sample Description: 2 of 2
Performed by: JE
Date: 9-20-2011

Sieve Size (mm)	% Finer
44.45	100%
31.75	98%
19	87%
4	45%
2	29%
0.5	8%
0.25	1%
0.074	0%

Figure G.9.4.

Grain size gradation curve for the sediment sample collected from the Arkansas River in the vicinity of H-11-AA

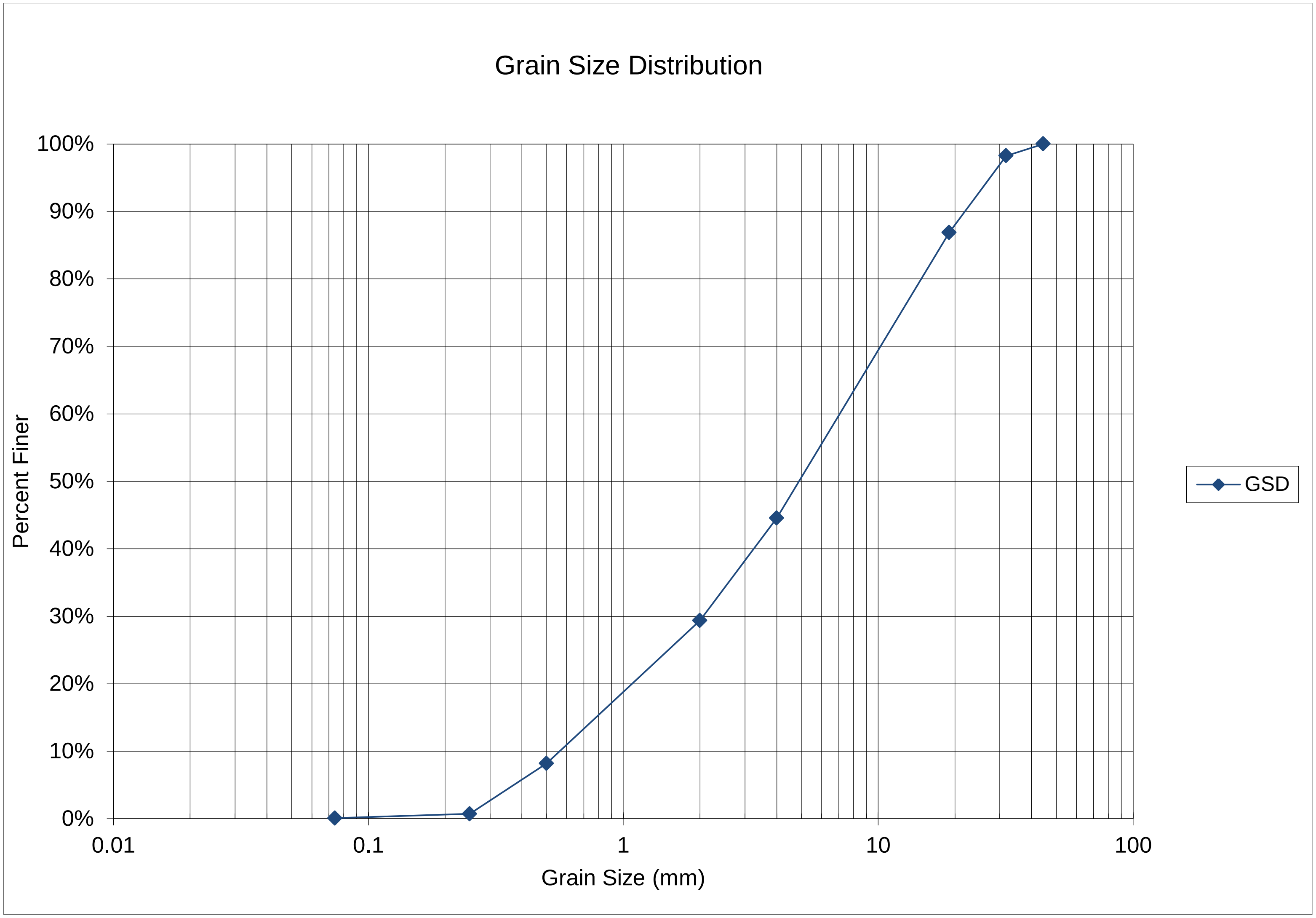


Table G.9.4.

Grain size gradation computations for the sediment sample collected from the Arkansas River in the vicinity of H-11-AA

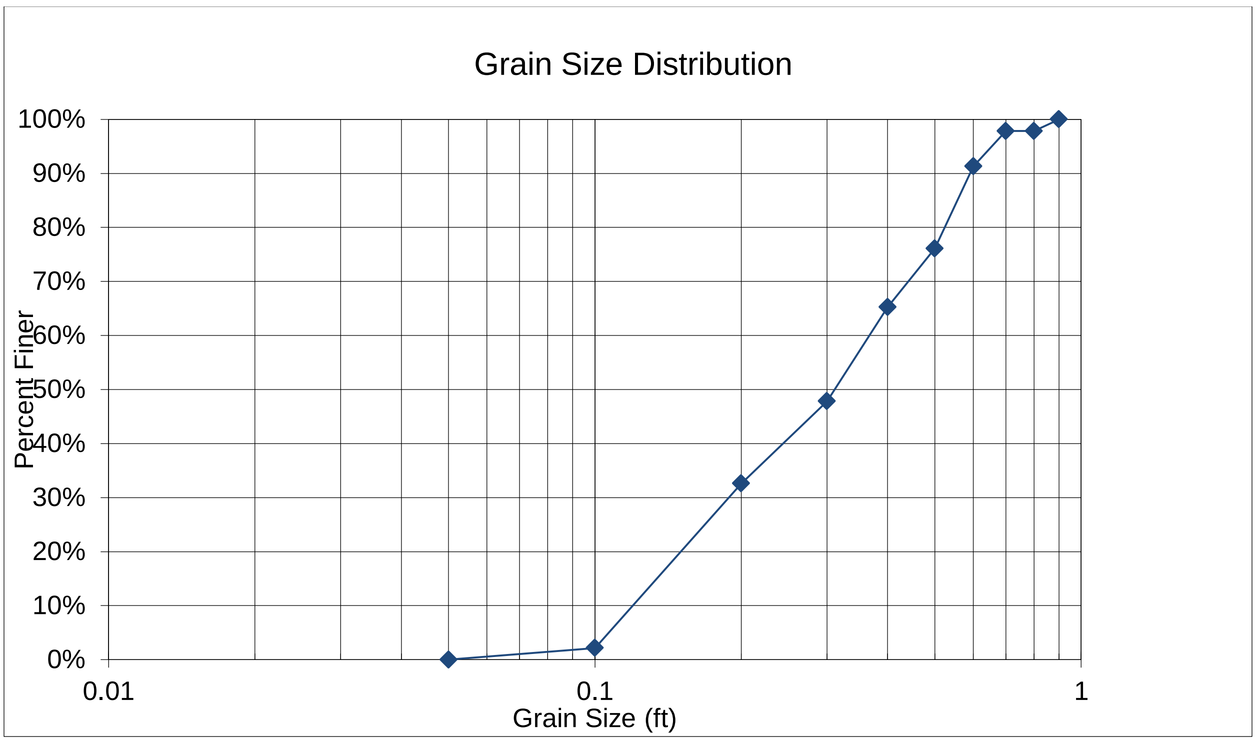
Structure # H-11-AA	**Waterbody - Arkansas River**	**Sample # 2 of 2**	Performed by: BS and JE Date: 9/14/2011			
Sieve Size (mm)	Weight of Sieve (g)	Weight of Sieve + Soil (g)	Weight of Soil (g)	% Retained	Cumulative % Ret.	% Finer
44.45	0	0	0	0%	0%	100%
31.75	550.22	635.63	85.41	2%	2%	98%
19	651.7	1201.8	550.1	11%	13%	87%
4	520.5	2569.5	2049	42%	55%	45%
2	479.5	1214.3	734.8	15%	71%	29%
0.5	412.95	1438.4	1025.45	21%	92%	8%
0.25	389.74	752.12	362.38	7%	99%	1%
0.074	375.12	405.65	30.53	1%	100%	0%
Pan	371.99	376.2	4.21	0%	100%	0%
		Total Weight of Sample	**4841.88**			

Pebble Count Grain Size Distribution

Region	Structure ID	County	Facility Carried	Mile Marker	POA Fiscal Year	Feature Intersected	D_{50} min from POA	D_{50} max from POA	Date
3	H-11-AA	Lake	SH 300 ML	0.4	2012	Arkansas River	5	13	8/8/2013

Sample #	A (ft)	B (ft)	C (ft)	Shape Factor	D_s (ft)	D_{avg} (ft)	Volume (ft³)
1	0.3	0.17	0.18	0.797	0.17	0.217	0.005
2	0.31	0.16	0.11	0.494	0.16	0.193	0.003
3	0.07	0.05	0.05	0.845	0.05	0.057	0.000
4	0.18	0.15	0.05	0.304	0.15	0.127	0.001
5	0.23	0.19	0.13	0.622	0.19	0.183	0.003
6	0.4	0.35	0.11	0.294	0.35	0.287	0.008
7	0.22	0.16	0.11	0.586	0.16	0.163	0.002
8	0.35	0.21	0.19	0.701	0.21	0.250	0.007
9	0.42	0.35	0.23	0.600	0.35	0.333	0.018
10	0.28	0.18	0.14	0.624	0.18	0.200	0.004
11	1.33	0.68	0.68	0.715	0.68	0.897	0.322
12	0.85	0.65	0.65	0.874	0.65	0.717	0.188
13	0.51	0.34	0.19	0.456	0.34	0.347	0.017
14	0.8	0.59	0.16	0.233	0.59	0.517	0.040
15	0.65	0.45	0.15	0.277	0.45	0.417	0.023
16	0.51	0.29	0.11	0.286	0.29	0.303	0.009
17	0.31	0.18	0.3	1.270	0.18	0.263	0.009
18	0.15	0.11	0.06	0.467	0.11	0.107	0.001
19	0.44	0.32	0.12	0.320	0.32	0.293	0.009
20	0.24	0.22	0.13	0.566	0.22	0.197	0.004
21	0.2	0.17	0.09	0.488	0.17	0.153	0.002
22	0.84	0.59	0.18	0.256	0.59	0.537	0.047
23	0.61	0.56	0.25	0.428	0.56	0.473	0.045
24	0.24	0.15	0.1	0.527	0.15	0.163	0.002
25	0.35	0.26	0.21	0.696	0.26	0.273	0.010
26	0.66	0.46	0.23	0.417	0.46	0.450	0.037
27	0.54	0.44	0.25	0.513	0.44	0.410	0.031
28	0.4	0.35	0.28	0.748	0.35	0.343	0.021
29	1.1	0.88	0.28	0.285	0.88	0.753	0.142
30	0.27	0.23	0.06	0.241	0.23	0.187	0.002
31	0.46	0.43	0.26	0.585	0.43	0.383	0.027
32	0.3	0.23	0.15	0.571	0.23	0.227	0.005
33	0.6	0.52	0.38	0.680	0.52	0.500	0.062
34	0.3	0.19	0.13	0.545	0.19	0.207	0.004
35	0.8	0.54	0.28	0.426	0.54	0.540	0.063
36	0.7	0.62	0.32	0.486	0.62	0.547	0.073
37	0.54	0.35	0.22	0.506	0.35	0.370	0.022
38	0.47	0.46	0.12	0.258	0.46	0.350	0.014
39	0.61	0.28	0.22	0.532	0.28	0.370	0.020
40	0.83	0.59	0.36	0.514	0.59	0.593	0.092
41	0.25	0.19	0.18	0.826	0.19	0.207	0.004
42	0.56	0.38	0.21	0.455	0.38	0.383	0.023
43	0.21	0.14	0.07	0.408	0.14	0.140	0.001
44	0.49	0.36	0.13	0.310	0.36	0.327	0.012
45	0.15	0.14	0.07	0.483	0.14	0.120	0.001
46	0.61	0.59	0.17	0.283	0.59	0.457	0.032

Structure # H-11-AA	Arkansas River at SH 300			
Sieve Size (ft)	Samples Retained	% Retained	Cumulative % Ret.	% Finer
0.9	0	0%	0%	100%
0.8	1	2%	2%	98%
0.7	0	0%	2%	98%
0.6	3	7%	9%	91%
0.5	7	15%	24%	76%
0.4	5	11%	35%	65%
0.3	8	17%	52%	48%
0.2	7	15%	67%	33%
0.1	14	30%	98%	2%
0.05	1	2%	100%	0%
Total Samples	46			



Two sediment samples were collected from the channel bed near Bridge H-11-U. Results of the sediment size analysis for the sediment sample collected from the channel are presented below in both tabular and graphical formats.

Figure G.10.1.
Photo of sediment sample from the H-11-U site

Table G.10.1.
Sediment sieve analysis
Sample ID: H-11-U Lake Fork Creek
Sample Description: 1 of 2
Performed by: JE
Date: 9-14-2011

Sieve Size (mm)	% Finer
60	100%
44.45	100%
31.75	75%
19	65%
4	54%
2	44%
0.5	14%
0.25	3%
0.074	0%

Figure G.10.2.

Grain size gradation curve for the sediment sample collected from Lake Fork Creek in the vicinity of H-11-U

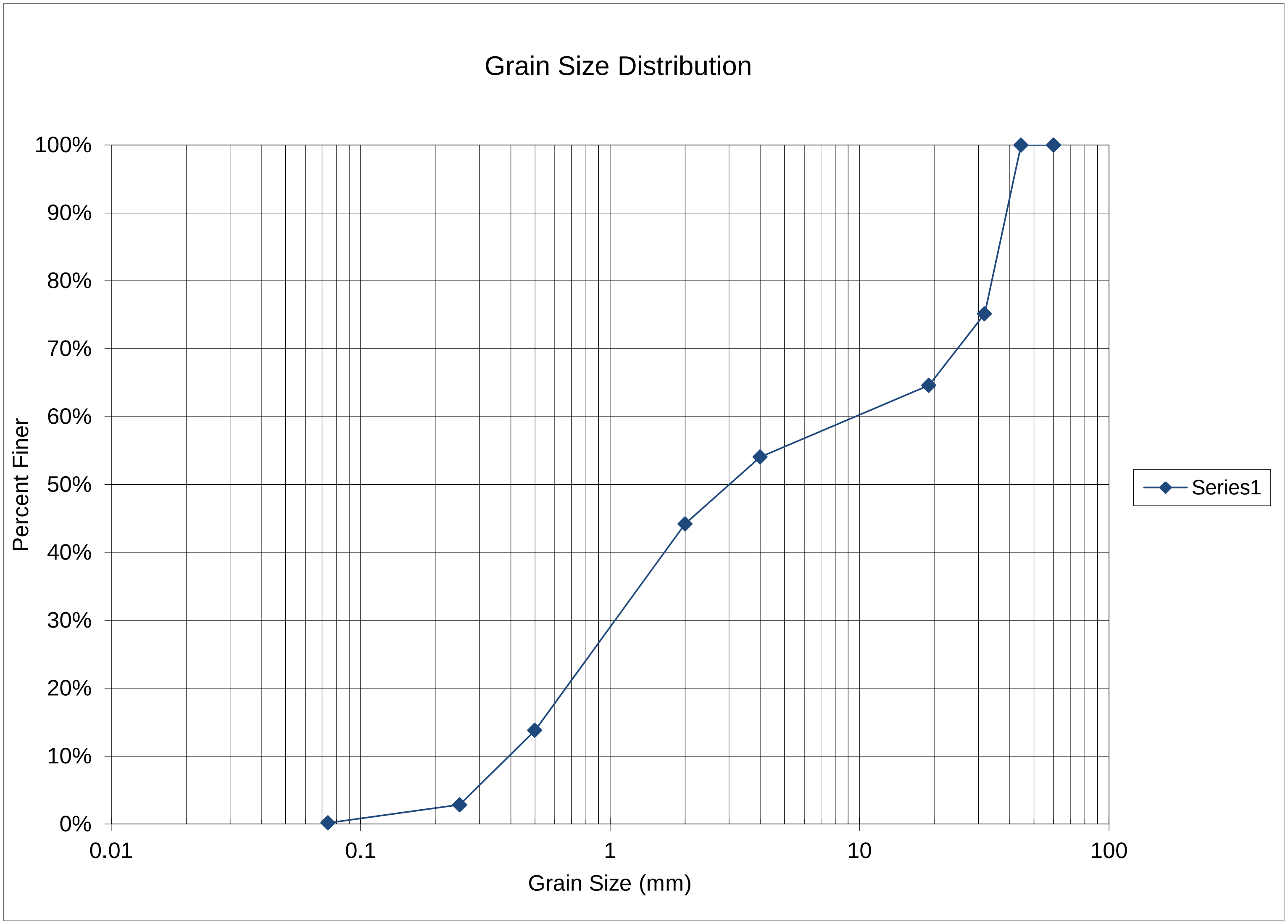


Table G.10.2.

Grain size gradation computations for the sediment sample collected from Lake Fork Creek in the vicinity of H-11-U

Structure # H-11-U	**Waterbody - Lake Fort Creek**	**Sample # 1 of 2**	Performed by: BS and JE Date: 9/14/2011			
Sieve Size (mm)	Weight of Sieve (g)	Weight of Sieve + Soil (g)	Weight of Soil (g)	% Retained	Cumulative % Ret.	% Finer
60	0	0	0	0%	0%	100%
44.45	0	0	0	0%	0%	100%
31.75	550.22	1732.2	1181.98	25%	25%	75%
19	651.7	1153.3	501.6	11%	35%	65%
4	520.5	1023.1	502.6	11%	46%	54%
2	479.5	947.84	468.34	10%	56%	44%
0.5	412.95	1858.8	1445.85	30%	86%	14%
0.25	389.79	911.12	521.33	11%	97%	3%
0.074	375.12	502.53	127.41	3%	100%	0%
Pan	371.99	380.12	8.13	0%	100%	0%
		Total Weight of Sample	**4757.24**			

Figure G.10.3.
Photo of sediment sample from the H-11-U site

Table G.10.3.
Sediment sieve analysis
Sample ID: H-11-U Lake Fork Creek
Sample Description: 2 of 2
Performed by: JE
Date: 9-14-2011

Sieve Size (mm)	% Finer
44.45	100%
31.75	85%
19	58%
4	33%
2	22%
0.5	3%
0.25	0%
0.074	0%

Figure G.10.4.

Grain size gradation curve for the sediment sample collected from Lake Fork Creek in the vicinity of H-11-U

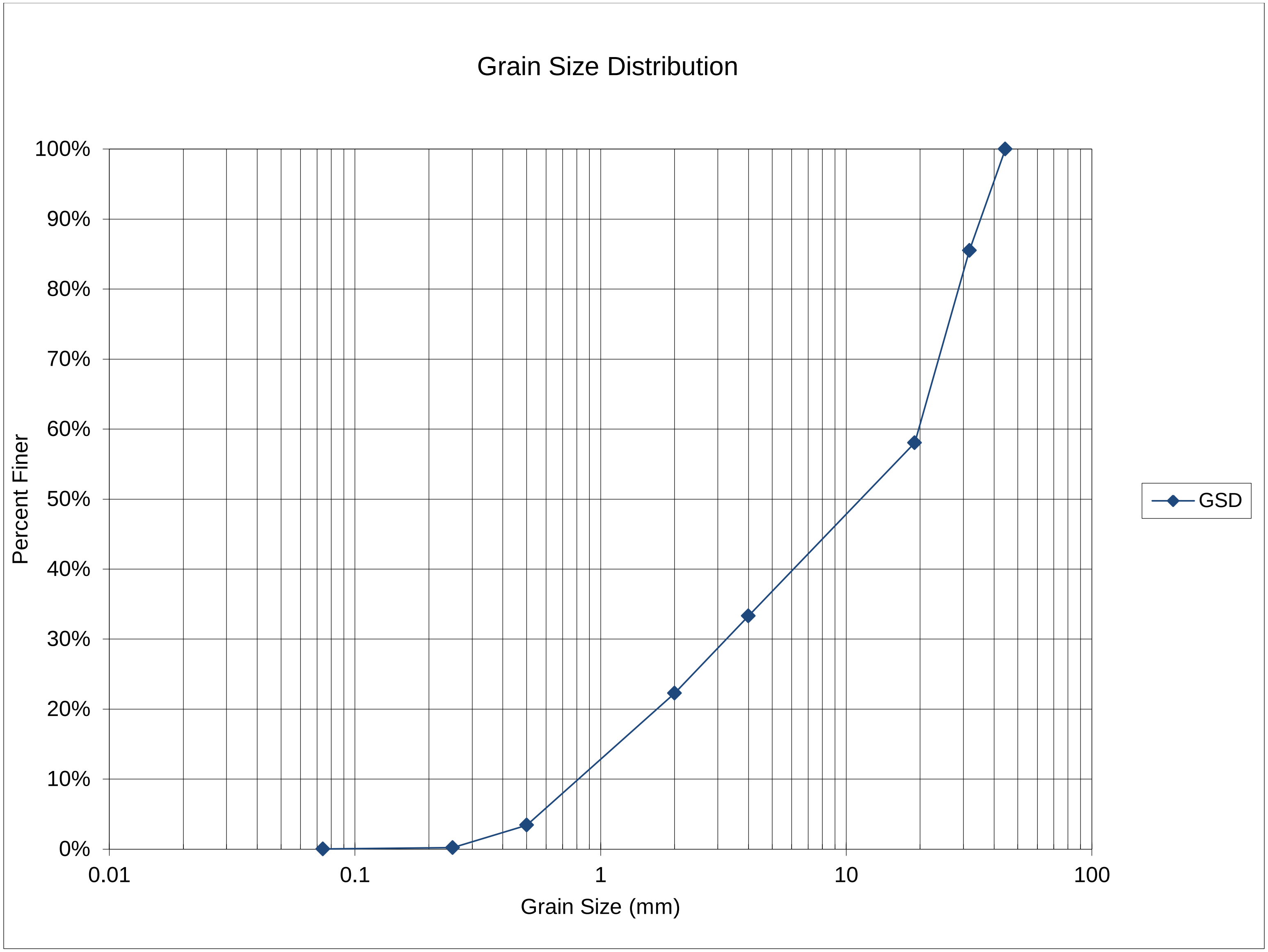


Table G.10.4.

Grain size gradation computations for the sediment sample collected from Lake Fork Creek in the vicinity of H-11-U

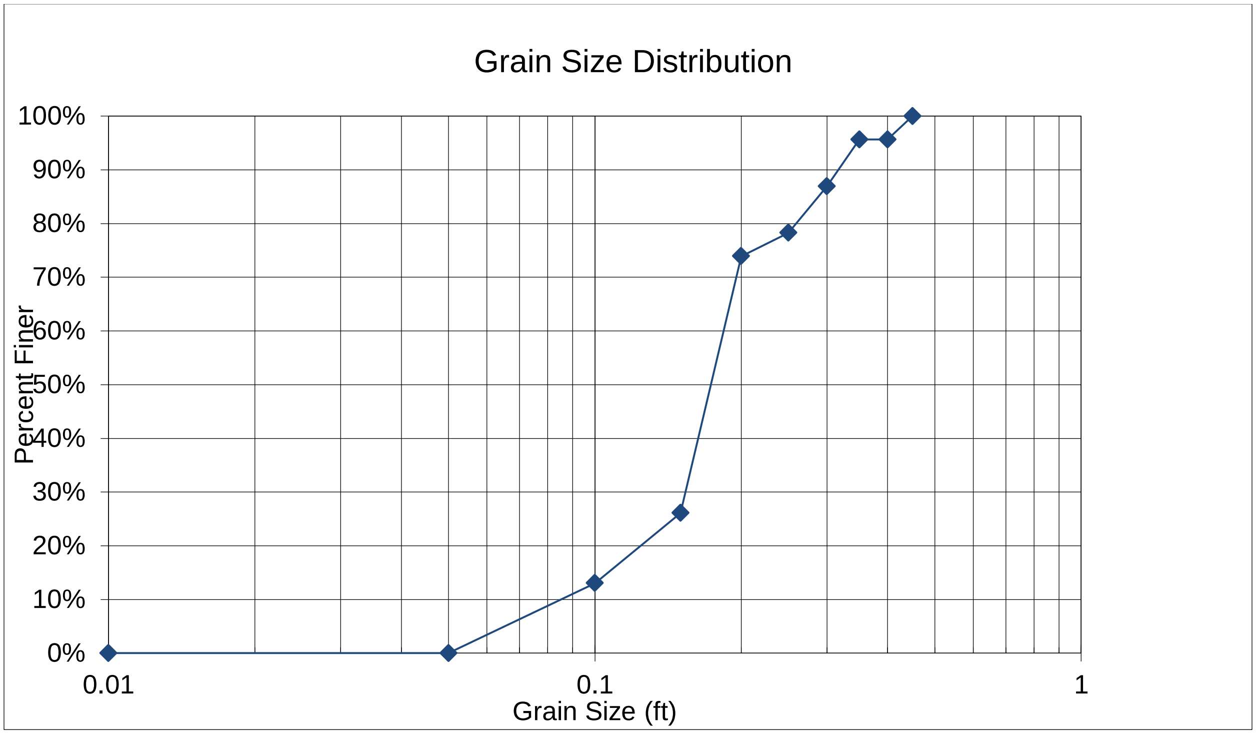
Structure # H-11-U	**Waterbody - Lake Fork Creek**	**Sample # 2 of 2**	Performed by: BS and JE Date: 9/14/2011			
Sieve Size (mm)	Weight of Sieve (g)	Weight of Sieve + Soil (g)	Weight of Soil (g)	% Retained	Cumulative % Ret.	% Finer
44.45	0	0	0	0%	0%	100%
31.75	550.22	1274.8	724.58	14%	14%	86%
19	651.7	2027.3	1375.6	27%	42%	58%
4	520.5	1759	1238.5	25%	67%	33%
2	479.5	1032.8	553.3	11%	78%	22%
0.5	412.95	1355.7	942.75	19%	97%	3%
0.25	389.79	550.3	160.51	3%	100%	0%
0.074	368.12	378.2	10.08	0%	100%	0%
Pan	371.99	372.4	0.41	0%	100%	0%
		Total Weight of Sample	**5005.73**			

Pebble Count Grain Size Distribution

Region	Structure ID	County	Facility Carried	Mile Marker	POA Fiscal Year	Feature Intersected	D_{50} min from POA	D_{50} max from POA	Date
3	H-11-U	Lake	SH 300 ML	1.6	2012	Lake Fork Creek	3	12	8/8/2013

Sample #	A (ft)	B (ft)	C (ft)	Shape Factor	D_s (ft)	D_{avg} (ft)	Volume (ft^3)
1	0.47	0.33	0.21	0.533	0.33	0.337	0.017
2	0.72	0.41	0.17	0.313	0.41	0.433	0.026
3	0.43	0.28	0.05	0.144	0.28	0.253	0.003
4	0.5	0.3	0.06	0.155	0.3	0.287	0.005
5	0.13	0.13	0.08	0.615	0.13	0.113	0.001
6	0.11	0.07	0.03	0.342	0.07	0.070	0.000
7	0.14	0.14	0.1	0.714	0.14	0.127	0.001
8	0.2	0.15	0.1	0.577	0.15	0.150	0.002
9	0.35	0.18	0.13	0.518	0.18	0.220	0.004
10	0.22	0.16	0.04	0.213	0.16	0.140	0.001
11	0.28	0.2	0.06	0.254	0.2	0.180	0.002
12	0.1	0.09	0.04	0.422	0.09	0.077	0.000
13	0.1	0.06	0.05	0.645	0.06	0.070	0.000
14	0.51	0.16	0.15	0.525	0.16	0.273	0.006
15	0.26	0.16	0.09	0.441	0.16	0.170	0.002
16	0.28	0.18	0.11	0.490	0.18	0.190	0.003
17	0.17	0.12	0.08	0.560	0.12	0.123	0.001
18	0.24	0.19	0.1	0.468	0.19	0.177	0.002
19	0.24	0.19	0.07	0.328	0.19	0.167	0.002
20	0.3	0.25	0.16	0.584	0.25	0.237	0.006
21	0.18	0.16	0.05	0.295	0.16	0.130	0.001
22	0.28	0.19	0.16	0.694	0.19	0.210	0.004
23	0.29	0.19	0.12	0.511	0.19	0.200	0.003

Structure # H-11-U	Lake Fork Creek at SH 300			
Sieve Size (ft)	Samples Retained	% Retained	Cumulative % Ret.	% Finer
0.45	0	0%	0%	100%
0.4	1	4%	4%	96%
0.35	0	0%	4%	96%
0.3	2	9%	13%	87%
0.25	2	9%	22%	78%
0.2	1	4%	26%	74%
0.15	11	48%	74%	26%
0.1	3	13%	87%	13%
0.05	3	13%	100%	0%
0.01	0	0%	100%	0%
Pan	0	0%	100%	0%
Total Samples	23			

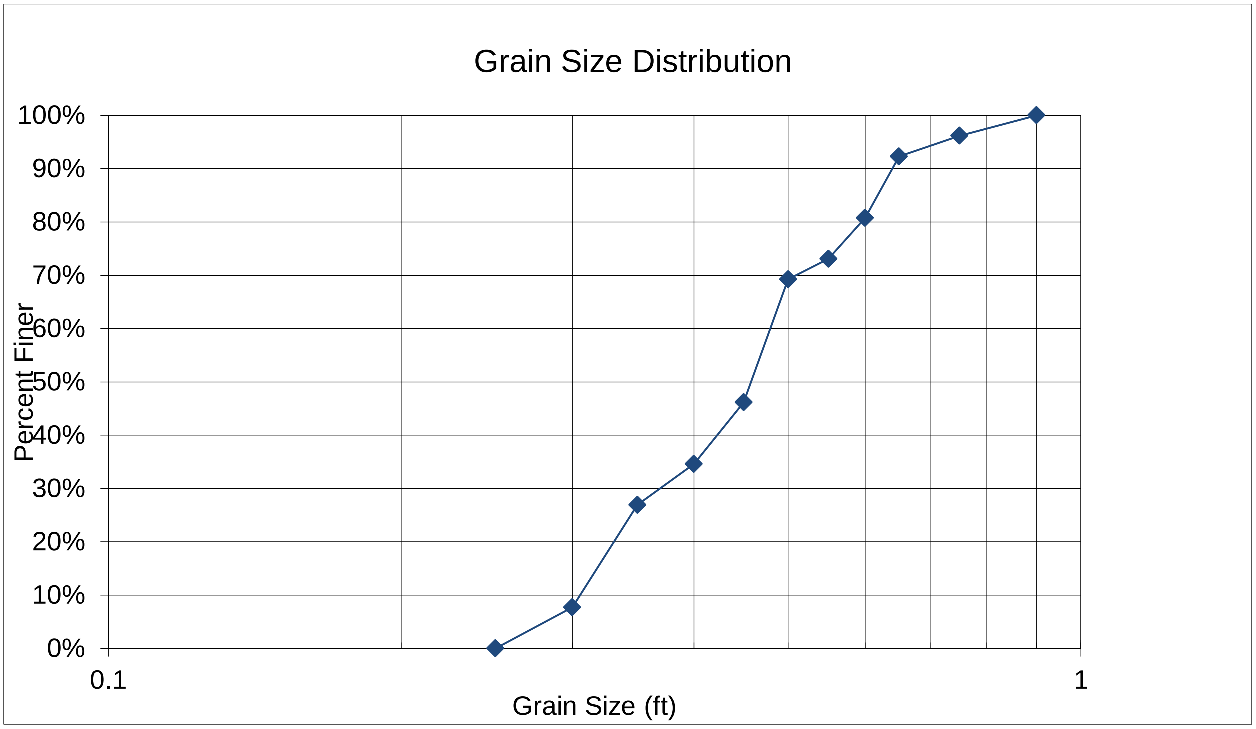


Pebble Count Grain Size Distribution

Region	Structure ID	County	Facility Carried	Mile Marker	POA Fiscal Year	Feature Intersected	D_{50} min from POA	D_{50} max from POA	Date
3	H-11-U	Lake	SH 300 ML	1.6	2012	Lake Fork Creek	3	12	9/12/2013

Sample #	A (ft)	B (ft)	C (ft)	Shape Factor	D_s (ft)	D_{avg} (ft)	Volume (ft^3)
1	0.66	0.46	0.25	0.454	0.46	0.457	0.040
2	0.33	0.27	0.15	0.503	0.27	0.250	0.007
3	0.32	0.3	0.06	0.194	0.3	0.227	0.003
4	0.5	0.32	0.3	0.750	0.32	0.373	0.025
5	0.74	0.45	0.12	0.208	0.45	0.437	0.021
6	0.78	0.47	0.32	0.529	0.47	0.523	0.061
7	0.8	0.62	0.4	0.568	0.62	0.607	0.104
8	0.53	0.36	0.23	0.527	0.36	0.373	0.023
9	0.47	0.33	0.1	0.254	0.33	0.300	0.008
10	0.46	0.4	0.25	0.583	0.4	0.370	0.024
11	0.53	0.45	0.28	0.573	0.45	0.420	0.035
12	0.5	0.25	0.06	0.170	0.25	0.270	0.004
13	0.8	0.8	0.36	0.450	0.8	0.653	0.121
14	0.63	0.52	0.35	0.611	0.52	0.500	0.060
15	0.47	0.33	0.25	0.635	0.33	0.350	0.020
16	0.34	0.34	0.11	0.324	0.34	0.263	0.007
17	0.5	0.45	0.3	0.632	0.45	0.417	0.035
18	0.42	0.36	0.1	0.257	0.36	0.293	0.008
19	0.8	0.65	0.5	0.693	0.65	0.650	0.136
20	0.65	0.57	0.28	0.460	0.57	0.500	0.054
21	0.56	0.43	0.24	0.489	0.43	0.410	0.030
22	0.7	0.48	0.46	0.794	0.48	0.547	0.081
23	1	0.55	0.35	0.472	0.55	0.633	0.101
24	0.65	0.42	0.3	0.574	0.42	0.457	0.043
25	0.6	0.6	0.22	0.367	0.6	0.473	0.041
26	0.9	0.65	0.55	0.719	0.65	0.700	0.168

Structure # H-11-U	Lake Fork Creek at SH 300			
Sieve Size (ft)	Samples Retained	% Retained	Cumulative % Ret.	% Finer
0.9	0	0%	0%	100%
0.75	1	4%	4%	96%
0.65	2	8%	12%	92%
0.6	2	8%	19%	81%
0.55	2	8%	27%	73%
0.5	1	4%	31%	69%
0.45	6	23%	54%	46%
0.4	3	12%	65%	35%
0.35	2	8%	73%	27%
0.3	5	19%	92%	8%
0.25	2	8%	100%	0%
Total Samples	26			



Sediment particles in the channel bed near Structure I-06-C, consists of gravel, large cobbles, and boulders.

Figure G.11.1.
Photo of cobbles and boulders from the I-06-C site

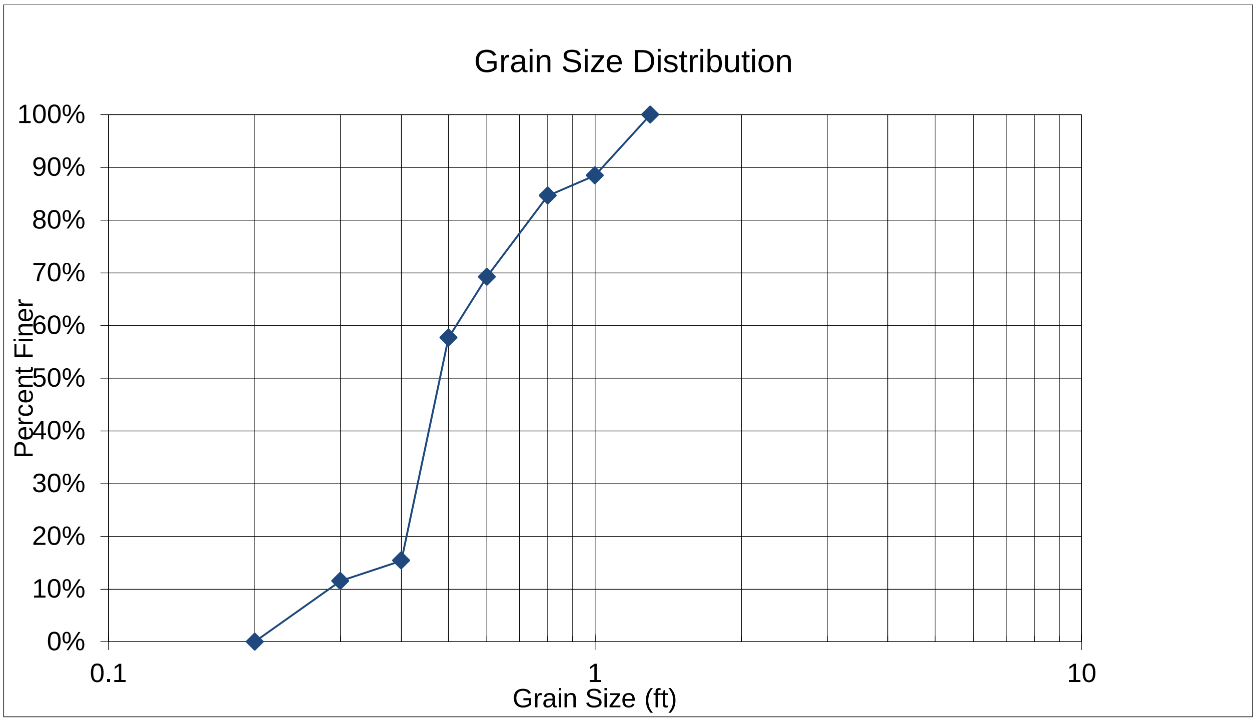
Figure G.11.2.
Photo of cobbles and boulders from the I-06-C site

Pebble Count Grain Size Distribution

Region	Structure ID	County	Facility Carried	Mile Marker	POA Fiscal Year	Feature Intersected	Date
3	I-06-C	Delta	SH 187 ML	0.41	2012	North Fork Gunnison River	9/11/2013

Sample #	A (ft)	B (ft)	C (ft)	Shape Factor	D_s (ft)	D_{avg} (ft)	Volume (ft^3)
1	1.1	0.45	0.4	0.569	0.45	0.650	0.104
2	0.75	0.66	0.3	0.426	0.66	0.570	0.078
3	0.5	0.4	0.3	0.671	0.4	0.400	0.031
4	0.6	0.45	0.25	0.481	0.45	0.433	0.035
5	1.1	1.2	0.75	0.653	1.2	1.017	0.518
6	0.3	0.25	0.1	0.365	0.25	0.217	0.004
7	1	1.1	0.25	0.238	1.1	0.783	0.144
8	0.6	0.6	0.12	0.200	0.6	0.440	0.023
9	0.6	0.6	0.3	0.500	0.6	0.500	0.057
10	0.4	0.4	0.15	0.375	0.4	0.317	0.013
11	0.45	0.47	0.2	0.435	0.47	0.373	0.022
12	0.6	0.3	0.3	0.707	0.3	0.400	0.028
13	0.75	0.5	0.2	0.327	0.5	0.483	0.039
14	1.08	0.92	0.38	0.381	0.92	0.793	0.198
15	0.57	0.51	0.16	0.297	0.51	0.413	0.024
16	1.11	1.02	0.55	0.517	1.02	0.893	0.326
17	0.51	0.49	0.21	0.420	0.49	0.403	0.027
18	0.65	0.42	0.22	0.421	0.42	0.430	0.031
19	0.61	0.45	0.21	0.401	0.45	0.423	0.030
20	0.73	0.42	0.14	0.253	0.42	0.430	0.022
21	0.46	0.25	0.17	0.501	0.25	0.293	0.010
22	0.61	0.58	0.3	0.504	0.58	0.497	0.056
23	0.62	0.61	0.18	0.293	0.61	0.470	0.036
24	0.45	0.4	0.11	0.259	0.4	0.320	0.010
25	0.6	0.43	0.31	0.610	0.43	0.447	0.042
26	0.43	0.28	0.14	0.403	0.28	0.283	0.009

Structure # I -06-C	North Fork Gunnison River at SH 187			
Sieve Size (ft)	Samples Retained	% Retained	Cumulative % Ret.	% Finer
1.3	0	0%	0%	100%
1	3	12%	12%	88%
0.8	1	4%	15%	85%
0.6	4	15%	31%	69%
0.5	3	12%	42%	58%
0.4	11	42%	85%	15%
0.3	1	4%	88%	12%
0.2	3	12%	100%	0%
Total Samples	26			



Hydraulic Analysis Report

Project Data

Project Title: I-06-C

Designer:

Project Date: Monday, September 23, 2013

Project Units: U.S. Customary Units

Notes:

Wolman Count Analysis: Rock/Sediment Gradation Analysis

Notes:

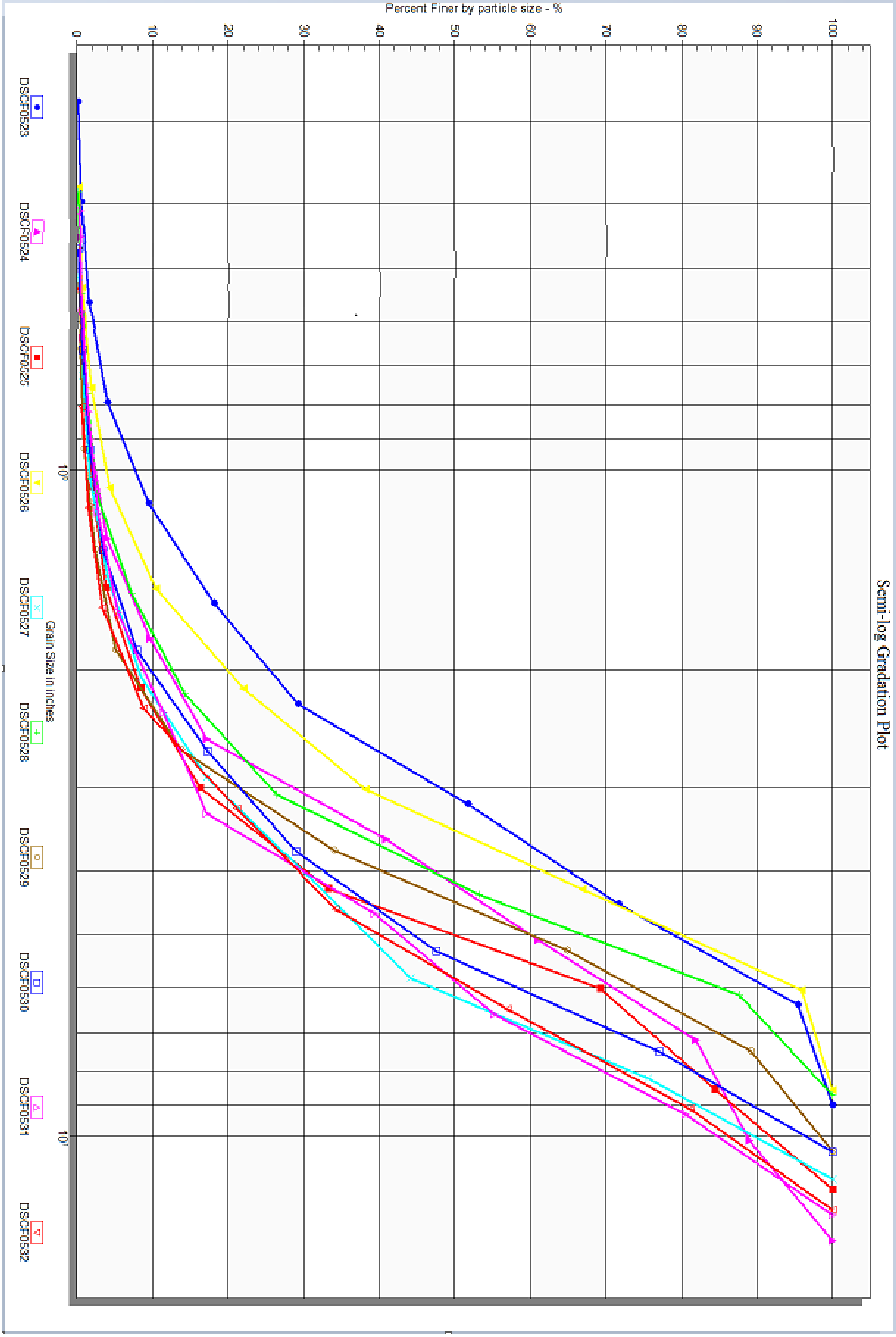

Semi-log Gradation Plot
Percent Finer by particle size - %
0
10
20
30
40
50
60
70
80
90
100
Grain Size in inches
10^0
10^1
DSCF0523
DSCF0524
DSCF0525
DSCF0526
DSCF0527
DSCF0528
DSCF0529
DSCF0530
DSCF0531
DSCF0532

Image Gradation Input Parameters

Name: Digital Gradation Analysis

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0523.JPG

Scale Line Length: 48 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 189

Morphologic Iterations: 1

Resolution: 28 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.070227	0	0	0.000000
0.099316	0	0	0.000000
0.140454	0	0	0.000000
0.198632	0	0	0.000000
0.280908	2	2	0.172861
0.397264	4	6	0.518583
0.561816	13	19	1.642178
0.794528	28	47	4.062230
1.123632	63	110	9.507347
1.589056	100	210	18.150389
2.247265	128	338	29.213483
3.178112	260	598	51.685393
4.494529	231	829	71.650821
6.356224	275	1104	95.419188
8.989058	53	1157	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.8512 in

D15: 1.4194 in

D50: 3.1083 in

D85: 5.5401 in

D100: 8.9891 in

Image Gradation Input Parameters

Name: DSCF0524

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0524.JPG

Scale Line Length: 48 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 173

Morphologic Iterations: 1

Resolution: 28 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.079400	0	0	0.000000
0.112288	0	0	0.000000
0.158799	0	0	0.000000
0.224576	0	0	0.000000
0.317598	0	0	0.000000
0.449152	2	2	0.302115
0.635197	3	5	0.755287
0.898304	6	11	1.661631
1.270394	15	26	3.927492
1.796608	38	64	9.667674
2.540787	50	114	17.220544
3.593216	157	271	40.936556
5.081575	133	404	61.027190
7.186432	138	542	81.873112
10.163150	47	589	88.972810
14.372864	73	662	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.3687 in

D15: 2.3220 in

D50: 4.2647 in

D85: 8.4975 in

D100: 14.3729 in

Image Gradation Input Parameters

Name: DSCF0525

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0525.JPG

Scale Line Length: 48 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 165

Morphologic Iterations: 1

Resolution: 29 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.066481	0	0	0.000000
0.094018	0	0	0.000000
0.132962	0	0	0.000000
0.188036	0	0	0.000000
0.265923	0	0	0.000000
0.376072	0	0	0.000000
0.531846	1	1	0.226244
0.752144	3	4	0.904977
1.063692	5	9	2.036199
1.504288	8	17	3.846154
2.127384	20	37	8.371041
3.008576	35	72	16.289593
4.254769	75	147	33.257919
6.017152	159	306	69.230769
8.509538	67	373	84.389140
12.034304	69	442	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.6632 in

D15: 2.8651 in

D50: 5.0750 in

D85: 8.6475 in

D100: 12.0343 in

Image Gradation Input Parameters

Name: DSCF0526

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0526.JPG

Scale Line Length: 48 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 186

Morphologic Iterations: 1

Resolution: 28 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.047167	0	0	0.000000
0.066704	0	0	0.000000
0.094334	0	0	0.000000
0.133408	0	0	0.000000
0.188667	0	0	0.000000
0.266816	0	0	0.000000
0.377335	2	2	0.272109
0.533632	3	5	0.680272
0.754670	9	14	1.904762
1.067264	18	32	4.353741
1.509339	45	77	10.476190
2.134528	85	162	22.040816
3.018678	119	281	38.231293
4.269056	211	492	66.938776
6.037357	213	705	95.918367
8.538112	30	735	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.1139 in

D15: 1.7539 in

D50: 3.5313 in

D85: 5.3711 in

D100: 8.5381 in

Image Gradation Input Parameters

Name: DSCF0527

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0527.JPG

Scale Line Length: 48 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 168

Morphologic Iterations: 1

Resolution: 28 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.090657	0	0	0.000000
0.128208	0	0	0.000000
0.181313	0	0	0.000000
0.256416	0	0	0.000000
0.362627	0	0	0.000000
0.512832	1	1	0.249377
0.725254	2	3	0.748130
1.025664	4	7	1.745636
1.450508	9	16	3.990025
2.051328	18	34	8.478803
2.901016	35	69	17.206983
4.102656	55	124	30.922693
5.802032	53	177	44.139651
8.205312	126	303	75.561097
11.604064	98	401	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.5857 in

D15: 2.6862 in

D50: 6.2503 in

D85: 9.5180 in

D100: 11.6041 in

Image Gradation Input Parameters

Name: DSCF0528

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0528.JPG

Scale Line Length: 48 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 178

Morphologic Iterations: 1

Resolution: 29 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.067913	0	0	0.000000
0.096044	0	0	0.000000
0.135827	0	0	0.000000
0.192088	0	0	0.000000
0.271653	0	0	0.000000
0.384176	1	1	0.182149
0.543307	2	3	0.546448
0.768352	4	7	1.275046
1.086614	7	14	2.550091
1.536704	26	40	7.285974
2.173228	38	78	14.207650
3.073408	67	145	26.411658
4.346455	147	292	53.187614
6.146816	189	481	87.613843
8.692911	68	549	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.3194 in

D15: 2.2317 in

D50: 4.1949 in

D85: 6.0101 in

D100: 8.6929 in

Image Gradation Input Parameters

Name: DSCF0529

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0529.JPG

Scale Line Length: 48 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 169

Morphologic Iterations: 1

Resolution: 28 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.082389	0	0	0.000000
0.116516	0	0	0.000000
0.164779	0	0	0.000000
0.233032	0	0	0.000000
0.329557	0	0	0.000000
0.466064	1	1	0.240964
0.659114	1	2	0.481928
0.932128	2	4	0.963855
1.318228	6	10	2.409639
1.864256	11	21	5.060241
2.636456	36	57	13.734940
3.728512	84	141	33.975904
5.272912	128	269	64.819277
7.457024	101	370	89.156627
10.545824	45	415	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.8518 in

D15: 2.7047 in

D50: 4.5309 in

D85: 7.0840 in

D100: 10.5458 in

Image Gradation Input Parameters

Name: DSCF0530

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0530.JPG

Scale Line Length: 48 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 176

Morphologic Iterations: 1

Resolution: 28 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.082623	0	0	0.000000
0.116846	0	0	0.000000
0.165245	0	0	0.000000
0.233692	0	0	0.000000
0.330490	0	0	0.000000
0.467384	1	1	0.189394
0.660981	3	4	0.757576
0.934768	5	9	1.704545
1.321962	9	18	3.409091
1.869536	24	42	7.954545
2.643923	49	91	17.234848
3.739072	62	153	28.977273
5.287846	98	251	47.537879
7.478144	156	407	77.083333
10.575693	121	528	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.5136 in

D15: 2.4574 in

D50: 5.4704 in

D85: 8.5482 in

D100: 10.5757 in

Image Gradation Input Parameters

Name: DSCF0531

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0531.JPG

Scale Line Length: 48 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 171

Morphologic Iterations: 1

Resolution: 30 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.072560	0	0	0.000000
0.102616	0	0	0.000000
0.145121	0	0	0.000000
0.205232	0	0	0.000000
0.290242	0	0	0.000000
0.410464	2	2	0.326797
0.580484	2	4	0.653595
0.820928	5	9	1.470588
1.160968	8	17	2.777778
1.641856	16	33	5.392157
2.321935	37	70	11.437908
3.283712	35	105	17.156863
4.643870	136	241	39.379085
6.567424	97	338	55.228758
9.287740	155	493	80.555556
13.134848	119	612	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.5697 in

D15: 2.9210 in

D50: 5.9328 in

D85: 10.1671 in

D100: 13.1348 in

Image Gradation Input Parameters

Name: DSCF0532

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0532.JPG

- Scale Line Length: 48 in
- Median Filter Radius: 2 px
- Background Subtraction Radius: 3 px
- Advanced Controls:
  - Automate Threshold Selection
  - Threshold Value: 180
  - Morphologic Iterations: 1
  - Resolution: 30 %
  - Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.071341	0	0	0.000000
0.100892	0	0	0.000000
0.142683	0	0	0.000000
0.201784	0	0	0.000000
0.285366	0	0	0.000000
0.403568	0	0	0.000000
0.570731	0	0	0.000000
0.807136	2	2	0.606061
1.141463	3	5	1.515152
1.614272	6	11	3.333333
2.282925	18	29	8.787879
3.228544	41	70	21.212121
4.565851	43	113	34.242424
6.457088	75	188	56.969697
9.131701	80	268	81.212121
12.914176	62	330	100.000000

One sediment sample was collected from the channel bed near Structure J-01-C. Results of the sediment size analysis for the sediment sample collected from the channel are presented below in both tabular and graphical formats.

Figure G.12.1.
Photo of sediment sample from the J-01-C site

Table G.12.1.
Sediment sieve analysis
Sample ID: J-01-C Dolores River
Sample Description: 1 of 2
Performed by: JE
Date: 10-03-2011

Sieve Size (mm)	% Finer
60	100%
44.45	100%
22.43	57%
19.1	54%
4	32%
2	21%
1	15%
0.5	13%
0.25	1%

Figure G.12.2.

Grain size gradation curve for the sediment sample collected from the Dolores River in the vicinity of J-01-C

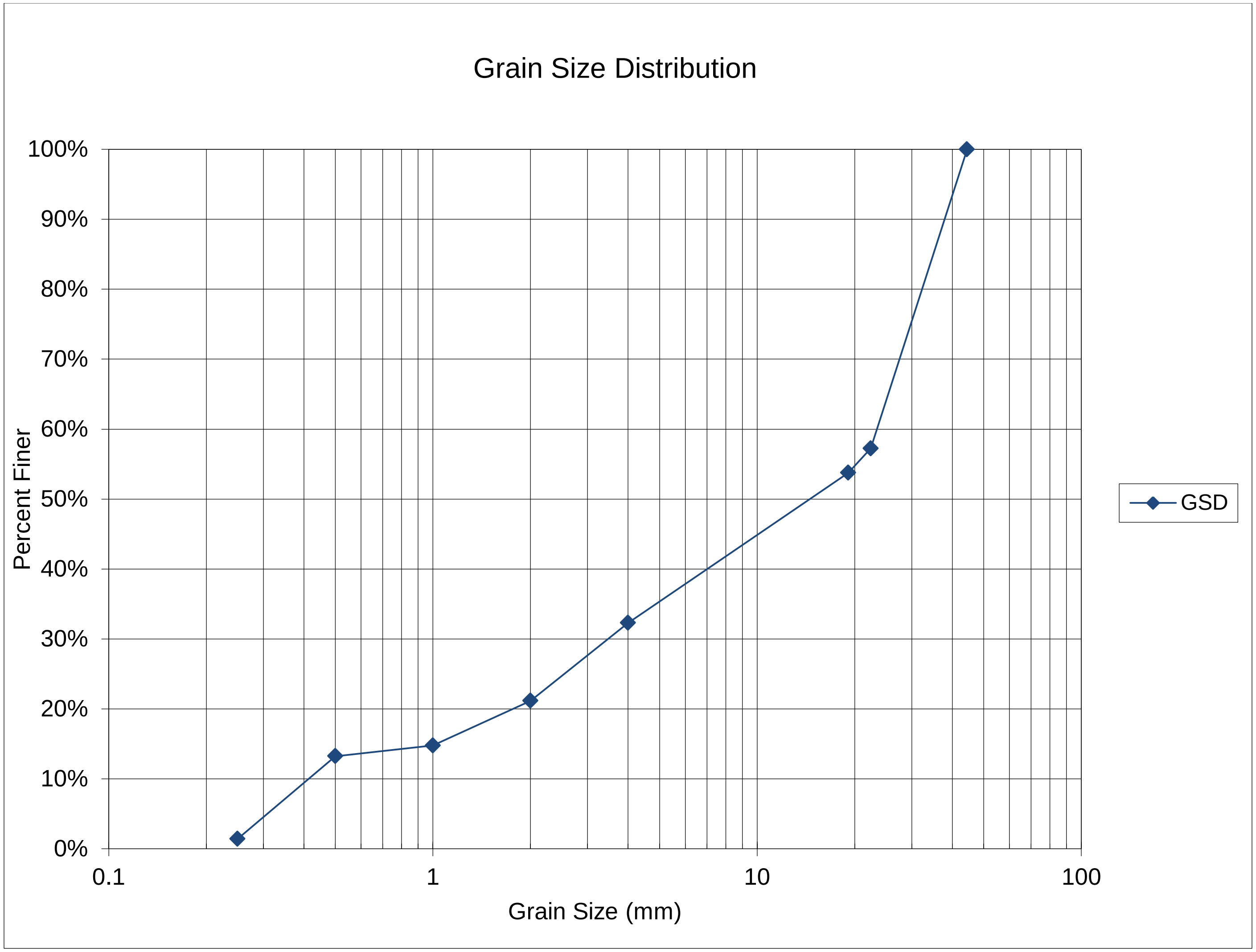


Table G.12.2.

Grain size gradation computations for the sediment sample collected from the Dolores River in the vicinity of J-01-C

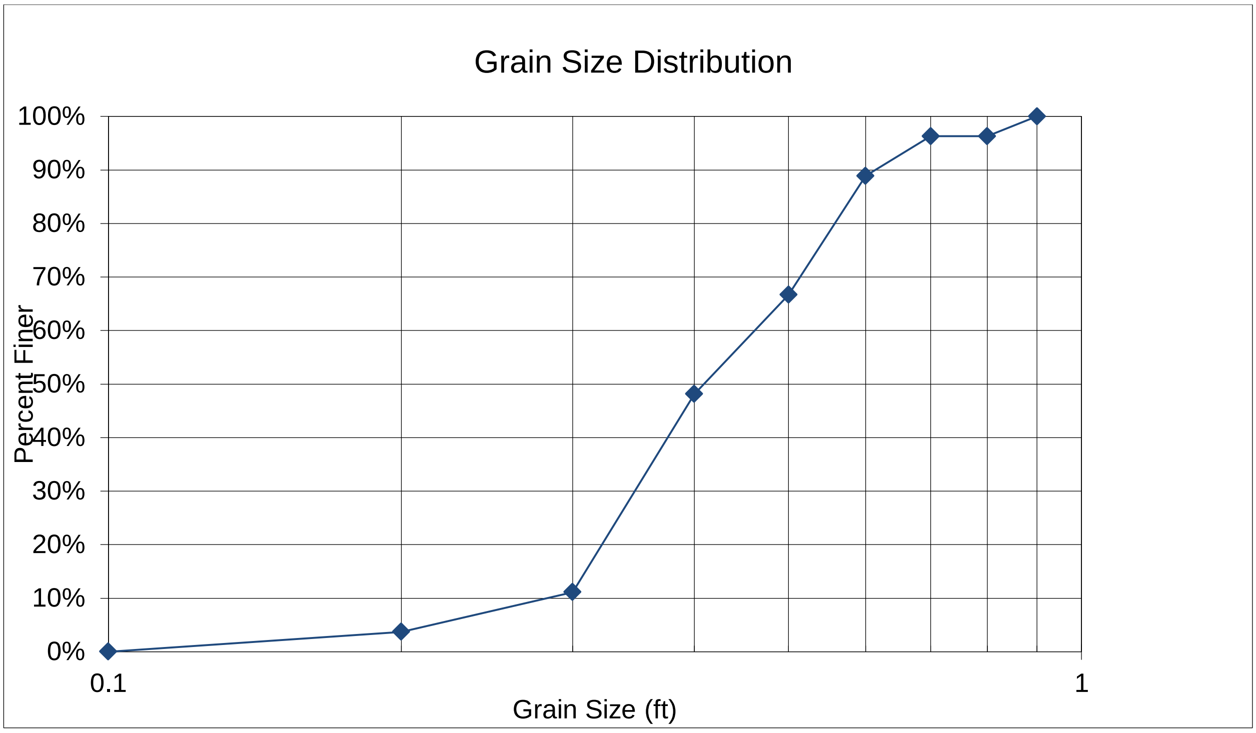
Structure # J-01-C	**Waterbody - Dolores River**	**Sample # 1 of 1**	Performed by: JE Date: 10/03/2011			
Sieve Size (mm)	Weight of Sieve (g)	Weight of Sieve + Soil (g)	Weight of Soil (g)	% Retained	Cumulative % Ret.	% Finer
60	0	0	0	0%	0%	100%
44.45	0	0	0	0%	0%	100%
22.43	554.93	2350.2	1795.27	43%	43%	57%
19.1	652.12	798.4	146.28	3%	46%	54%
4	566.85	1468	901.15	21%	68%	32%
2	484.03	951.74	467.71	11%	79%	21%
1	453.26	720.9	267.64	6%	85%	15%
0.5	419.39	483.66	64.27	2%	87%	13%
0.25	392.71	888.56	495.85	12%	99%	1%
Pan	368.73	429.19	60.46	1%	100%	0%
		Total Weight of Sample	**4198.63**			

Pebble Count Grain Size Distribution

Region	Structure ID	County	Facility Carried	Mile Marker	POA Fiscal Year	Feature Intersected	D_{50} max from POA	Date
3	J-01-C	Mesa	SH 141 ML	110.9	2012	Dolores River	15	8/8/2013

Sample #	A (ft)	B (ft)	C (ft)	Shape Factor	D_s (ft)	D_{avg} (ft)	Volume (ft³)
1	0.44	0.36	0.27	0.678	0.36	0.357	0.022
2	0.24	0.15	0.09	0.474	0.15	0.160	0.002
3	0.68	0.3	0.25	0.554	0.3	0.410	0.027
4	0.56	0.48	0.24	0.463	0.48	0.427	0.034
5	0.34	0.23	0.15	0.536	0.23	0.240	0.006
6	0.86	0.39	0.34	0.587	0.39	0.530	0.060
7	0.58	0.37	0.31	0.669	0.37	0.420	0.035
8	0.79	0.61	0.29	0.418	0.61	0.563	0.073
9	1.11	0.86	0.57	0.583	0.86	0.847	0.285
10	0.41	0.31	0.22	0.617	0.31	0.313	0.015
11	0.47	0.35	0.16	0.394	0.35	0.327	0.014
12	0.49	0.42	0.13	0.287	0.42	0.347	0.014
13	1	0.52	0.46	0.638	0.52	0.660	0.125
14	0.85	0.58	0.39	0.555	0.58	0.607	0.101
15	0.87	0.56	0.34	0.487	0.56	0.590	0.087
16	0.51	0.36	0.2	0.467	0.36	0.357	0.019
17	0.43	0.34	0.19	0.497	0.34	0.320	0.015
18	0.66	0.49	0.28	0.492	0.49	0.477	0.047
19	0.61	0.52	0.43	0.763	0.52	0.520	0.071
20	0.46	0.34	0.24	0.607	0.34	0.347	0.020
21	0.72	0.53	0.32	0.518	0.53	0.523	0.064
22	0.41	0.34	0.11	0.295	0.34	0.287	0.008
23	0.81	0.54	0.37	0.559	0.54	0.573	0.085
24	0.43	0.41	0.12	0.286	0.41	0.320	0.011
25	0.66	0.47	0.36	0.646	0.47	0.497	0.058
26	1.22	0.65	0.53	0.595	0.65	0.800	0.220
27	0.31	0.27	0.11	0.380	0.27	0.230	0.005

Structure # J-01-C	Dolores River at SH 141			
Sieve Size (ft)	Samples Retained	% Retained	Cumulative % Ret.	% Finer
0.9	0	0%	0%	100%
0.8	1	4%	4%	96%
0.7	0	0%	4%	96%
0.6	2	7%	11%	89%
0.5	6	22%	33%	67%
0.4	5	19%	52%	48%
0.3	10	37%	89%	11%
0.2	2	7%	96%	4%
0.1	1	4%	100%	0%
Total Samples	27			



Hydraulic Analysis Report

Project Data

Project Title: J-01-C

Designer:

Project Date: Monday, September 23, 2013

Project Units: U.S. Customary Units

Notes:

Wolman Count Analysis: Hydraulic Toolbox GSD

Notes:

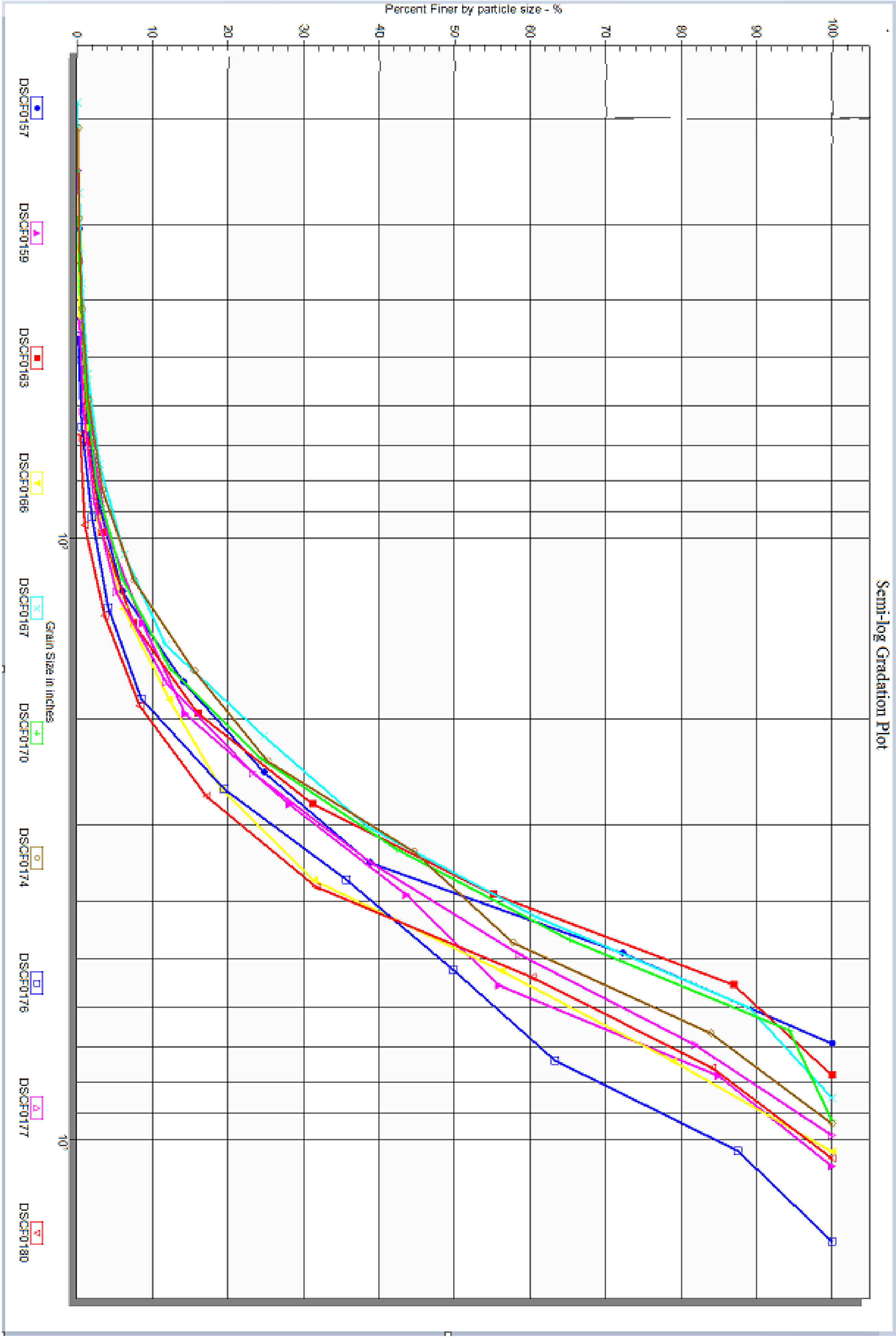

Semi-log Gradation Plot
Percent Finer by particle size - %
0
10
20
30
40
50
60
70
80
90
100
Grain Size in Inches
DSCF0157
DSCF0159
DSCF0163
DSCF0166
DSCF0167
DSCF0170
DSCF0174
DSCF0176
DSCF0177
DSCF0180

Image Gradation Input Parameters

Name: DSCF0157

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0157.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 167

Morphologic Iterations: 1

Resolution: 30 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.054020	0	0	0.000000
0.076395	0	0	0.000000
0.108039	0	0	0.000000
0.152790	0	0	0.000000
0.216078	0	0	0.000000
0.305581	1	1	0.198020
0.432156	1	2	0.396040
0.611161	4	6	1.188119
0.864313	8	14	2.772277
1.222323	16	30	5.940594
1.728625	41	71	14.059406
2.444645	54	125	24.752475
3.457250	71	196	38.811881
4.889290	169	365	72.277228
6.914501	140	505	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.1160 in

D15: 1.7916 in

D50: 3.9360 in

D85: 5.8187 in

D100: 6.9145 in

Image Gradation Input Parameters

Name: DSCF0159

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0159.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 166

Morphologic Iterations: 1

Resolution: 31 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.030586	0	0	0.000000
0.043255	0	0	0.000000
0.061172	0	0	0.000000
0.086510	0	0	0.000000
0.122344	0	0	0.000000
0.173021	0	0	0.000000
0.244688	1	1	0.154799
0.346041	1	2	0.309598
0.489376	4	6	0.928793
0.692082	7	13	2.012384
0.978752	13	26	4.024768
1.384164	30	56	8.668731
1.957504	37	93	14.396285
2.768329	89	182	28.173375
3.915008	100	282	43.653251
5.536657	79	361	55.882353
7.830016	188	549	84.984520
11.073314	97	646	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.0639 in

D15: 1.9930 in

D50: 4.7566 in

D85: 7.8334 in

D100: 11.0733 in

Image Gradation Input Parameters

Name: DSCF0163

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0163.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 174

Morphologic Iterations: 1

Resolution: 36 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.061069	0	0	0.000000
0.086364	0	0	0.000000
0.122138	0	0	0.000000
0.172729	0	0	0.000000
0.244275	0	0	0.000000
0.345457	2	2	0.217155
0.488550	3	5	0.542888
0.690915	8	13	1.411509
0.977101	17	30	3.257329
1.381829	39	69	7.491857
1.954202	78	147	15.960912
2.763658	140	287	31.161781
3.908403	221	508	55.157438
5.527317	293	801	86.970684
7.816806	120	921	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.1437 in

D15: 1.8893 in

D50: 3.6624 in

D85: 5.4270 in

D100: 7.8168 in

Image Gradation Input Parameters

Name: DSCF0166

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0166.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 165

Morphologic Iterations: 1

Resolution: 35 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.057832	0	0	0.000000
0.081787	0	0	0.000000
0.115665	0	0	0.000000
0.163574	0	0	0.000000
0.231329	0	0	0.000000
0.327149	1	1	0.150376
0.462658	2	3	0.451128
0.654297	4	7	1.052632
0.925316	11	18	2.706767
1.308595	23	41	6.165414
1.850632	40	81	12.180451
2.617189	47	128	19.248120
3.701264	81	209	31.428571
5.234378	165	374	56.240602
7.402529	151	525	78.947368
10.468756	140	665	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.1794 in

D15: 2.1564 in

D50: 4.8488 in

D85: 8.2841 in

D100: 10.4688 in

Image Gradation Input Parameters

Name: DSCF0167

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0167.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 173

Morphologic Iterations: 1

Resolution: 43 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.047033	0	0	0.000000
0.066515	0	0	0.000000
0.094066	0	0	0.000000
0.133029	0	0	0.000000
0.188132	1	1	0.092166
0.266059	2	3	0.276498
0.376264	4	7	0.645161
0.532117	8	15	1.382488
0.752527	17	32	2.949309
1.064234	36	68	6.267281
1.505054	59	127	11.705069
2.128468	142	269	24.792627
3.010108	149	418	38.525346
4.256936	242	660	60.829493
6.020217	306	966	89.032258
8.513872	119	1085	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.9452 in

D15: 1.6620 in

D50: 3.6516 in

D85: 5.7681 in

D100: 8.5139 in

Image Gradation Input Parameters

Name: DSCF0170

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0170.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 167

Morphologic Iterations: 1

Resolution: 33 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.051382	0	0	0.000000
0.072666	0	0	0.000000
0.102765	0	0	0.000000
0.145332	0	0	0.000000
0.205530	0	0	0.000000
0.290663	1	1	0.125313
0.411060	3	4	0.501253
0.581326	6	10	1.253133
0.822120	11	21	2.631579
1.162653	27	48	6.015038
1.644239	50	98	12.280702
2.325306	97	195	24.436090
3.288479	143	338	42.355890
4.650612	183	521	65.288221
6.576958	232	753	94.360902
9.301223	45	798	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.0605 in

D15: 1.7966 in

D50: 3.7425 in

D85: 5.9567 in

D100: 9.3012 in

Image Gradation Input Parameters

Name: DSCF0174

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0174.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 168

Morphologic Iterations: 1

Resolution: 39 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.036691	0	0	0.000000
0.051889	0	0	0.000000
0.073382	0	0	0.000000
0.103778	0	0	0.000000
0.146764	0	0	0.000000
0.207555	1	1	0.123916
0.293528	1	2	0.247831
0.415111	3	5	0.619579
0.587055	7	12	1.486989
0.830221	15	27	3.345725
1.174110	34	61	7.558860
1.660442	64	125	15.489467
2.348220	79	204	25.278810
3.320885	156	360	44.609665
4.696440	106	466	57.744734
6.641769	211	677	83.890954
9.392880	130	807	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.9652 in

D15: 1.6304 in

D50: 3.8854 in

D85: 6.8312 in

D100: 9.3929 in

Image Gradation Input Parameters

Name: DSCF0176

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0176.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 175

Morphologic Iterations: 1

Resolution: 33 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.040748	0	0	0.000000
0.057627	0	0	0.000000
0.081497	0	0	0.000000
0.115254	0	0	0.000000
0.162994	0	0	0.000000
0.230508	0	0	0.000000
0.325988	0	0	0.000000
0.461016	1	1	0.166667
0.651975	3	4	0.666667
0.922033	8	12	2.000000
1.303951	13	25	4.166667
1.844065	26	51	8.500000
2.607902	66	117	19.500000
3.688130	97	214	35.666667
5.215804	85	299	49.833333
7.376260	81	380	63.333333
10.431607	145	525	87.500000
14.752521	75	600	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.4078 in

D15: 2.2954 in

D50: 5.2425 in

D85: 10.1155 in

D100: 14.7525 in

Image Gradation Input Parameters

Name: DSCF0177

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0177.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 169

Morphologic Iterations: 1

Resolution: 34 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.038380	0	0	0.000000
0.054277	0	0	0.000000
0.076760	0	0	0.000000
0.108555	0	0	0.000000
0.153519	0	0	0.000000
0.217109	0	0	0.000000
0.307039	0	0	0.000000
0.434218	2	2	0.323102
0.614078	3	5	0.807754
0.868437	9	14	2.261712
1.228155	18	32	5.169628
1.736874	41	73	11.793215
2.456311	71	144	23.263328
3.473748	98	242	39.095315
4.912621	121	363	58.642973
6.947495	144	507	81.906300
9.825242	112	619	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.2072 in

D15: 1.9380 in

D50: 4.2764 in

D85: 7.4395 in

D100: 9.8252 in

Image Gradation Input Parameters

Name: DSCF0180

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0180.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 178

Morphologic Iterations: 1

Resolution: 36 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.041955	0	0	0.000000
0.059333	0	0	0.000000
0.083909	0	0	0.000000
0.118666	0	0	0.000000
0.167819	0	0	0.000000
0.237331	0	0	0.000000
0.335637	0	0	0.000000
0.474663	0	0	0.000000
0.671275	2	2	0.424628
0.949326	3	5	1.061571
1.342549	12	17	3.609342
1.898652	22	39	8.280255
2.685099	42	81	17.197452
3.797303	68	149	31.634820
5.370197	135	284	60.297240
7.594606	112	396	84.076433
10.740395	75	471	100.000000

Two sediment samples were collected from the channel bed near Structure J-01-D. Results of the sediment size analysis for the sediment sample collected from the channel are presented below in both tabular and graphical formats.

Figure G.13.1.
Photo of sediment sample from the J-01-D site

Table G.13.1.
Sediment sieve analysis
Sample ID: J-01-D John Brown Creek
Sample Description: 1 of 2
Performed by: JE
Date: 9-29-2011

Sieve Size (mm)	% Finer
60	100%
44.45	100%
31.75	89%
16	73%
4	40%
2	31%
0.5	18%
0.25	4%
0.125	2%

Figure G.13.2.

Grain size gradation curve for the sediment sample collected from John Brown Creek in the vicinity of J-01-D

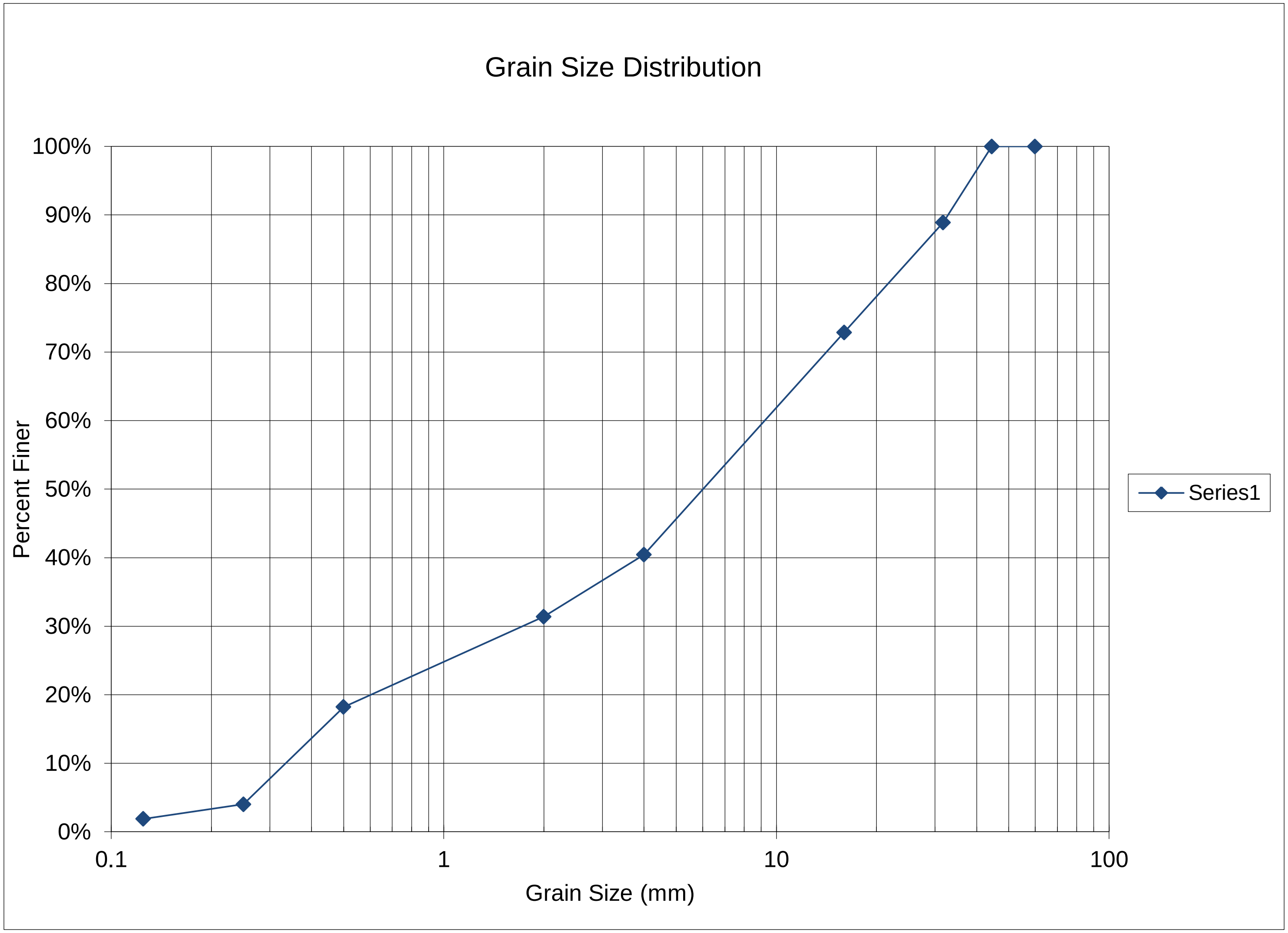


Table G.13.2.

Grain size gradation computations for the sediment sample collected from John Brown Creek in the vicinity of J-01-D

Structure # J-01-D	**Waterbody - John Brown Creek**	**Sample # 1 of 2**	Performed by: JE Date: 9/29/2011			
Sieve Size (mm)	Weight of Sieve (g)	Weight of Sieve + Soil (g)	Weight of Soil (g)	% Retained	Cumulative % Ret.	% Finer
60	0	0	0	0%	0%	100%
44.45	0	0	0	0%	0%	100%
31.75	534.4	1046.9	512.5	11%	11%	89%
16	602.69	1345.4	742.71	16%	27%	73%
4	566.86	2066.6	1499.74	32%	60%	40%
2	481.45	899.44	417.99	9%	69%	31%
0.5	413.2	1022.7	609.5	13%	82%	18%
0.25	390.17	1046.9	656.73	14%	96%	4%
0.125	377.23	475.82	98.59	2%	98%	2%
Pan	371.91	460	88.09	2%	100%	0%
		Total Weight of Sample	**4625.85**			

Figure G.13.3.
Photo of sediment sample from the J-01-D site

Table G.13.3.
Sediment sieve analysis
Sample ID: J-01-D John Brown Creek
Sample Description: 2 of 2
Performed by: JE
Date: 9-29-2011

Sieve Size (mm)	% Finer
60	100%
44.45	100%
22.43	50%
19.1	45%
4	26%
2	20%
0.5	9%
0.25	4%
0.125	1%

Figure G.13.4.

Grain size gradation curve for the sediment sample collected from John Brown Creek in the vicinity of J-01-D

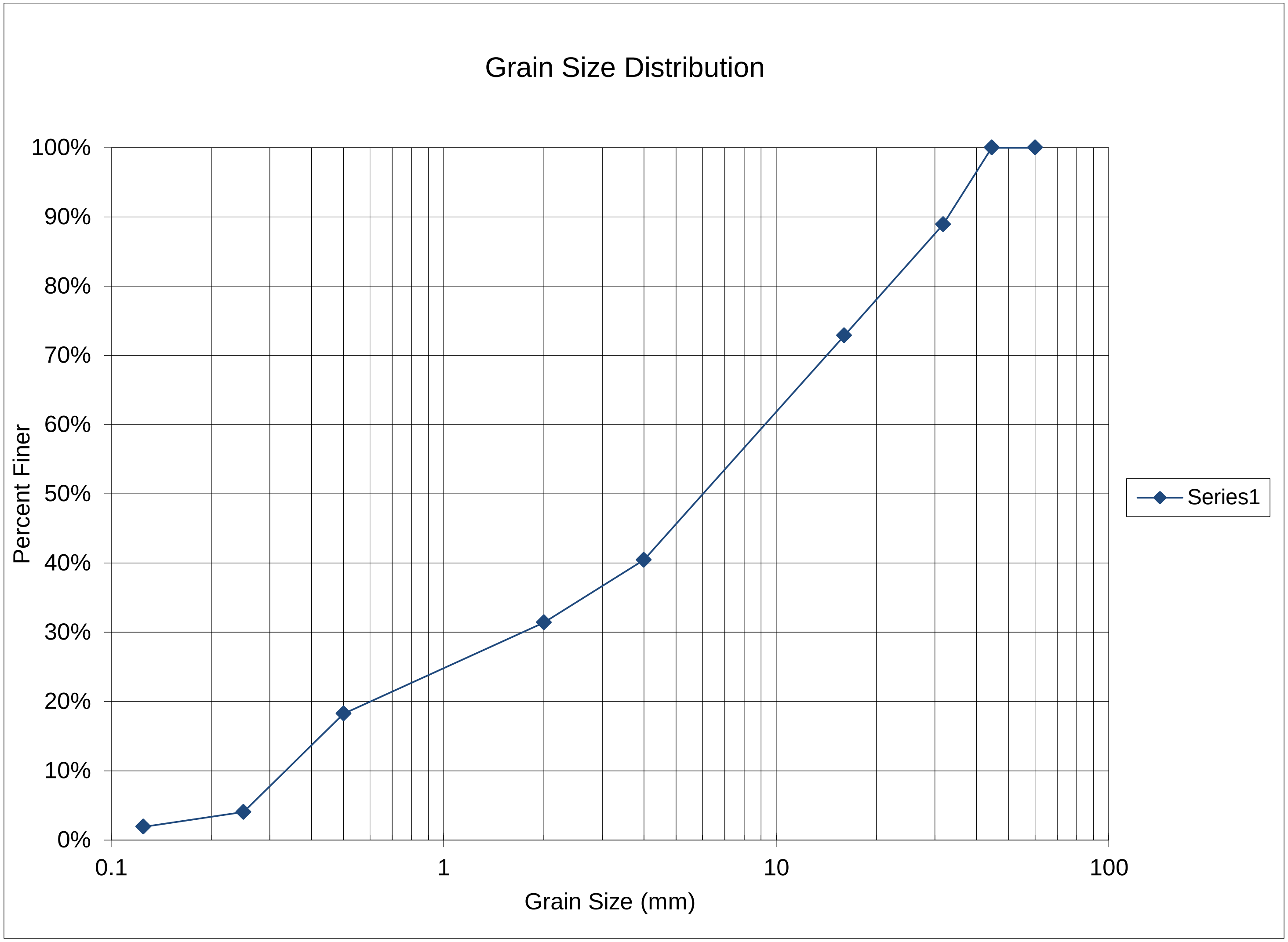


Table G.13.4.

Grain size gradation computations for the sediment sample collected from John Brown Creek in the vicinity of J-01-D

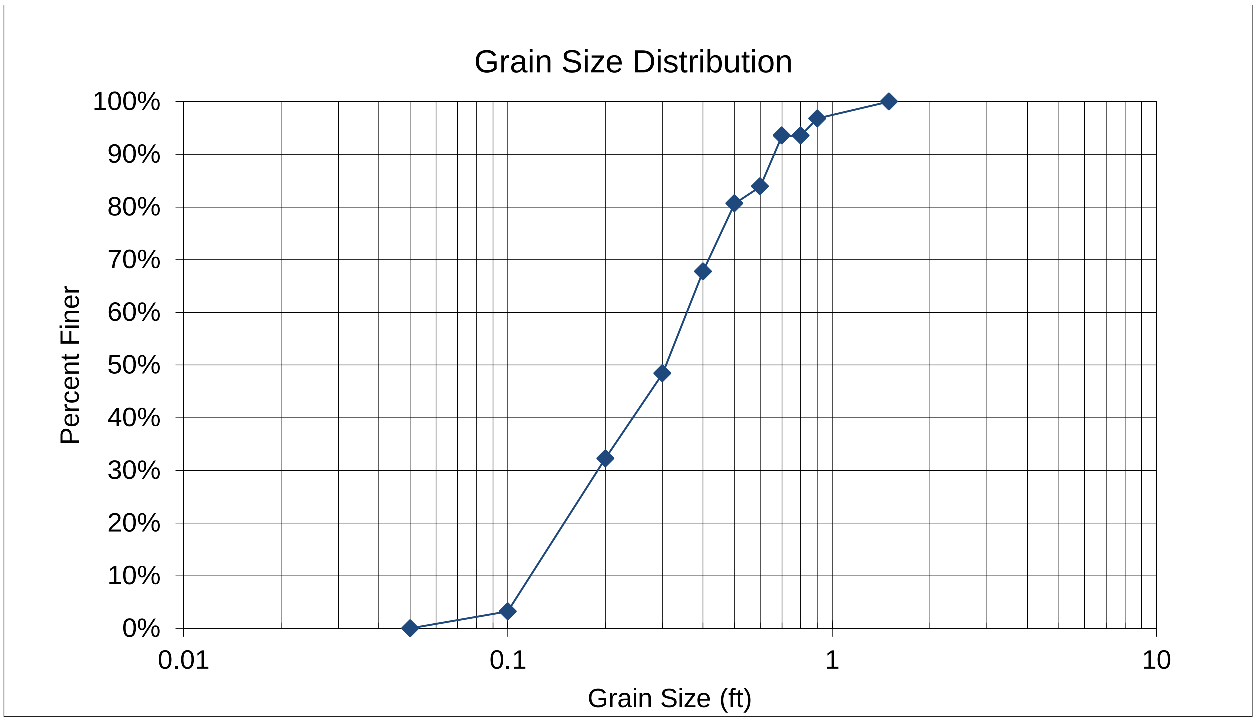
Structure # J-01-D	**Waterbody - John Brown Creek**	**Sample # 2 of 2**	Performed by: JE Date: 9/29/2011			
Sieve Size (mm)	Weight of Sieve (g)	Weight of Sieve + Soil (g)	Weight of Soil (g)	% Retained	Cumulative % Ret.	% Finer
60	0	0	0	0%	0%	100%
44.45	0	0	0	0%	0%	100%
22.43	541.21	2726	2184.79	50%	50%	50%
19.1	650.37	869.18	218.81	5%	55%	45%
4	567.62	1386.5	818.88	19%	74%	26%
2	464.7	711.16	246.46	6%	80%	20%
0.5	413.81	867.97	454.16	10%	91%	9%
0.25	401.07	641.65	240.58	6%	96%	4%
0.125	379.91	497.58	117.67	3%	99%	1%
Pan	368.32	421.18	52.86	1%	100%	0%
		Total Weight of Sample	**4334.21**			

Pebble Count Grain Size Distribution

Region	Structure ID	County	Facility Carried	Mile Marker	POA Fiscal Year	Feature Intersected	D_{50} max from POA	Date
3	J-01-D	Mesa	SH 141 ML	110.5	2012	John Brown Creek	4	8/8/2013

Sample #	A (ft)	B (ft)	C (ft)	Shape Factor	D_s (ft)	D_{avg} (ft)	Volume (ft^3)
1	0.29	0.18	0.04	0.175	0.18	0.170	0.001
2	0.84	0.48	0.45	0.709	0.48	0.590	0.095
3	0.17	0.15	0.09	0.564	0.15	0.137	0.001
4	0.3	0.2	0.17	0.694	0.2	0.223	0.005
5	0.63	0.52	0.23	0.402	0.52	0.460	0.039
6	0.51	0.32	0.11	0.272	0.32	0.313	0.009
7	0.31	0.15	0.04	0.185	0.15	0.167	0.001
8	0.79	0.61	0.24	0.346	0.61	0.547	0.061
9	0.2	0.13	0.08	0.496	0.13	0.137	0.001
10	0.39	0.31	0.18	0.518	0.31	0.293	0.011
11	0.36	0.33	0.12	0.348	0.33	0.270	0.007
12	0.35	0.31	0.09	0.273	0.31	0.250	0.005
13	0.22	0.15	0.09	0.495	0.15	0.153	0.002
14	0.84	0.63	0.33	0.454	0.63	0.600	0.091
15	0.49	0.41	0.27	0.602	0.41	0.390	0.028
16	0.28	0.19	0.11	0.477	0.19	0.193	0.003
17	0.64	0.42	0.24	0.463	0.42	0.433	0.034
18	0.31	0.15	0.12	0.556	0.15	0.193	0.003
19	1.6	0.89	0.45	0.377	0.89	0.980	0.336
20	0.35	0.21	0.18	0.664	0.21	0.247	0.007
21	0.54	0.38	0.29	0.640	0.38	0.403	0.031
22	0.19	0.16	0.06	0.344	0.16	0.137	0.001
23	0.19	0.09	0.06	0.459	0.09	0.113	0.001
24	0.34	0.23	0.14	0.501	0.23	0.237	0.006
25	0.58	0.34	0.16	0.360	0.34	0.360	0.017
26	0.34	0.21	0.1	0.374	0.21	0.217	0.004
27	1.2	0.68	0.52	0.576	0.68	0.800	0.222
28	0.54	0.41	0.25	0.531	0.41	0.400	0.029
29	0.37	0.19	0.13	0.490	0.19	0.230	0.005
30	0.36	0.27	0.18	0.577	0.27	0.270	0.009
31	2.69	1.42	1.2	0.614	1.42	1.770	2.400

Structure # J-01-D	John Brown Creek at SH 141			
Sieve Size (ft)	Samples Retained	% Retained	Cumulative % Ret.	% Finer
1.5	0	0%	0%	100%
0.9	1	3%	3%	97%
0.8	1	3%	6%	94%
0.7	0	0%	6%	94%
0.6	3	10%	16%	84%
0.5	1	3%	19%	81%
0.4	4	13%	32%	68%
0.3	6	19%	52%	48%
0.2	5	16%	68%	32%
0.1	9	29%	97%	3%
0.05	1	3%	100%	0%
Total Samples	31			



Hydraulic Analysis Report

Project Data

Project Title: J-01-D

Designer:

Project Date: Wednesday, September 25, 2013

Project Units: U.S. Customary Units

Notes:

Wolman Count Analysis: Hydraulic Toolbox GSD

Notes:

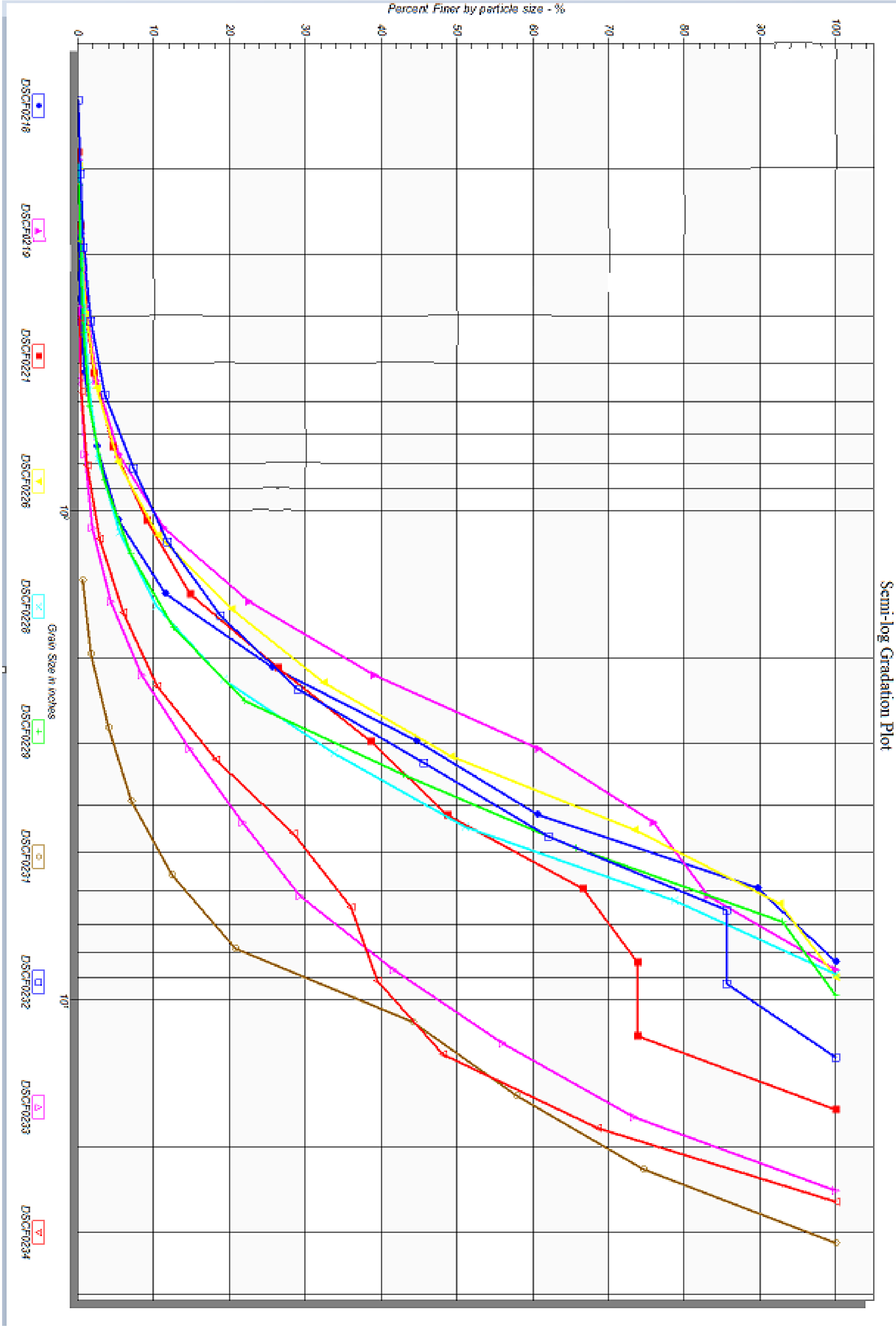

Semi-log Gradation Plot
Percent Finer by particle size - %
0
10
20
30
40
50
60
70
80
90
100
Grain Size in inches
10^0
10^1
DSCF0218
DSCF0219
DSCF0221
DSCF0226
DSCF0228
DSCF0229
DSCF0231
DSCF0232
DSCF0233
DSCF0234

Image Gradation Input Parameters

Name: DSCF0218

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0218.JPG

- *Scale Line Length: 24 in*
- *Median Filter Radius: 2 px*
- *Background Subtraction Radius: 3 px*
- *Advanced Controls:*
    - *Automate Threshold Selection*
    - *Threshold Value: 201*
    - *Morphologic Iterations: 1*
    - *Resolution: 34 %*
    - *Flood Depth: 0.9 px*

Gradation Results

Particle Size in	*Particle count*	*Cumulative Particle count*	*Cumulative Percent Finer (%)*
0.065399	*0*	*0*	*0.000000*
0.092488	*0*	*0*	*0.000000*
0.130798	*0*	*0*	*0.000000*
0.184976	*0*	*0*	*0.000000*
0.261595	*1*	*1*	*0.096805*
0.369951	*2*	*3*	*0.290416*
0.523190	*6*	*9*	*0.871249*
0.739902	*17*	*26*	*2.516941*
1.046380	*29*	*55*	*5.324298*
1.479805	*64*	*119*	*11.519845*
2.092760	*146*	*265*	*25.653437*
2.959610	*196*	*461*	*44.627299*
4.185520	*165*	*626*	*60.600194*
5.919220	*300*	*926*	*89.641820*
8.371041	*107*	*1033*	*100.000000*

Gradation Result Parameters

Gradation Result Parameters

D5: 1.0110 in

D15: 1.6307 in

D50: 3.3720 in

D85: 5.6421 in

D100: 8.3710 in

Image Gradation Input Parameters

Name: DSCF0219

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0219.JPG

- *Scale Line Length: 24 in*
- *Median Filter Radius: 2 px*
- *Background Subtraction Radius: 3 px*
- *Advanced Controls:*
    - *Automate Threshold Selection*
    - *Threshold Value: 216*
    - *Morphologic Iterations: 1*
    - *Resolution: 38 %*
    - *Flood Depth: 0.9 px*

Gradation Results

Particle Size in	*Particle count*	*Cumulative Particle count*	*Cumulative Percent Finer (%)*
0.048033	*0*	*0*	*0.000000*
0.067929	*0*	*0*	*0.000000*
0.096066	*0*	*0*	*0.000000*
0.135858	*0*	*0*	*0.000000*
0.192132	*2*	*2*	*0.134318*
0.271716	*4*	*6*	*0.402955*
0.384264	*10*	*16*	*1.074547*
0.543431	*21*	*37*	*2.484889*
0.768528	*44*	*81*	*5.439893*
1.086862	*87*	*168*	*11.282740*
1.537055	*169*	*337*	*22.632639*
2.173725	*245*	*582*	*39.086635*
3.074111	*323*	*905*	*60.779046*
4.347449	*227*	*1132*	*76.024177*
6.148222	*107*	*1239*	*83.210208*
8.694899	*250*	*1489*	*100.000000*

Gradation Result Parameters

Gradation Result Parameters

D5: 0.7350 in

D15: 1.2343 in

D50: 2.6267 in

D85: 6.4197 in

D100: 8.6949 in

Image Gradation Input Parameters

Name: DSCF0221

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0221.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 206

Morphologic Iterations: 1

Resolution: 32 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.065579	0	0	0.000000
0.092743	0	0	0.000000
0.131158	0	0	0.000000
0.185485	1	1	0.073801
0.262315	3	4	0.295203
0.370970	7	11	0.811808
0.524631	17	28	2.066421
0.741940	34	62	4.575646
1.049262	61	123	9.077491
1.483880	78	201	14.833948
2.098524	157	358	26.420664
2.967761	165	523	38.597786
4.197048	137	660	48.708487
5.935522	243	903	66.642066
8.394096	97	1000	73.800738
11.871044	0	1000	73.800738
16.788191	355	1355	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.7709 in

D15: 1.4927 in

D50: 4.3222 in

D85: 13.9730 in

D100: 16.7882 in

Image Gradation Input Parameters

Name: DSCF0226

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0226.JPG

- *Scale Line Length: 24 in*
- *Median Filter Radius: 2 px*
- *Background Subtraction Radius: 3 px*
- *Advanced Controls:*
    - *Automate Threshold Selection*
    - *Threshold Value: 209*
    - *Morphologic Iterations: 1*
    - *Resolution: 35 %*
    - *Flood Depth: 0.9 px*

Gradation Results

Particle Size in	*Particle count*	*Cumulative Particle count*	*Cumulative Percent Finer (%)*
0.049626	*0*	*0*	*0.000000*
0.070181	*0*	*0*	*0.000000*
0.099251	*0*	*0*	*0.000000*
0.140362	*0*	*0*	*0.000000*
0.198502	*1*	*1*	*0.089686*
0.280724	*3*	*4*	*0.358744*
0.397004	*8*	*12*	*1.076233*
0.561449	*16*	*28*	*2.511211*
0.794008	*31*	*59*	*5.291480*
1.122897	*59*	*118*	*10.582960*
1.588017	*108*	*226*	*20.269058*
2.245795	*135*	*361*	*32.376682*
3.176034	*188*	*549*	*49.237668*
4.491590	*270*	*819*	*73.452915*
6.352067	*213*	*1032*	*92.556054*
8.983180	*83*	*1115*	*100.000000*

Gradation Result Parameters

Gradation Result Parameters

D5: 0.7696 in

D15: 1.3350 in

D50: 3.2174 in

D85: 5.6162 in

D100: 8.9832 in

Image Gradation Input Parameters

Name: DSCF0228

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0228.JPG

- *Scale Line Length: 24 in*
- *Median Filter Radius: 2 px*
- *Background Subtraction Radius: 3 px*
- *Advanced Controls:*
  - *Automate Threshold Selection*
  - *Threshold Value: 193*
  - *Morphologic Iterations: 1*
  - *Resolution: 35 %*
  - *Flood Depth: 0.9 px*

Gradation Results

Particle Size in	*Particle count*	*Cumulative Particle count*	*Cumulative Percent Finer (%)*
0.049006	*0*	*0*	*0.000000*
0.069305	*0*	*0*	*0.000000*
0.098012	*0*	*0*	*0.000000*
0.138610	*0*	*0*	*0.000000*
0.196024	*1*	*1*	*0.111111*
0.277219	*2*	*3*	*0.333333*
0.392047	*4*	*7*	*0.777778*
0.554439	*6*	*13*	*1.444444*
0.784095	*11*	*24*	*2.666667*
1.108878	*25*	*49*	*5.444444*
1.568190	*44*	*93*	*10.333333*
2.217755	*80*	*173*	*19.222222*
3.136380	*131*	*304*	*33.777778*
4.435510	*156*	*460*	*51.111111*
6.272759	*248*	*708*	*78.666667*
8.871021	*192*	*900*	*100.000000*

Gradation Result Parameters

Gradation Result Parameters

D5: 1.0569 in

D15: 1.9092 in

D50: 4.3522 in

D85: 7.0441 in

D100: 8.8710 in

Image Gradation Input Parameters

Name: DSCF0229

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0229.JPG

- *Scale Line Length: 24 in*
- *Median Filter Radius: 2 px*
- *Background Subtraction Radius: 3 px*
- *Advanced Controls:*
  - *Automate Threshold Selection*
  - *Threshold Value: 208*
  - *Morphologic Iterations: 1*
  - *Resolution: 32 %*
  - *Flood Depth: 0.9 px*

Gradation Results

Particle Size in	*Particle count*	*Cumulative Particle count*	*Cumulative Percent Finer (%)*
0.038318	0	0	0.000000
0.054190	0	0	0.000000
0.076636	0	0	0.000000
0.108379	0	0	0.000000
0.153271	0	0	0.000000
0.216758	1	1	0.108342
0.306542	2	3	0.325027
0.433516	4	7	0.758397
0.613084	7	14	1.516793
0.867032	18	32	3.466956
1.226169	32	64	6.933911
1.734065	52	116	12.567714
2.452338	87	203	21.993499
3.468129	193	396	42.903575
4.904676	211	607	65.763814
6.936259	251	858	92.957746
9.809351	65	923	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.0258 in

D15: 1.9194 in

D50: 3.9141 in

D85: 6.3418 in

D100: 9.8094 in

Image Gradation Input Parameters

Name: DSCF0231

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0231.JPG

- *Scale Line Length: 24 in*
- *Median Filter Radius: 2 px*
- *Background Subtraction Radius: 3 px*
- *Advanced Controls:*
  - *Automate Threshold Selection*
  - *Threshold Value: 191*
  - *Morphologic Iterations: 1*
  - *Resolution: 28 %*
  - *Flood Depth: 0.9 px*

Gradation Results

Particle Size in	*Particle count*	*Cumulative Particle count*	*Cumulative Percent Finer (%)*
0.122788	*0*	*0*	*0.000000*
0.173648	*0*	*0*	*0.000000*
0.245575	*0*	*0*	*0.000000*
0.347296	*0*	*0*	*0.000000*
0.491151	*0*	*0*	*0.000000*
0.694592	*0*	*0*	*0.000000*
0.982302	*0*	*0*	*0.000000*
1.389184	*2*	*2*	*0.668896*
1.964603	*3*	*5*	*1.672241*
2.778368	*7*	*12*	*4.013378*
3.929206	*9*	*21*	*7.023411*
5.556737	*16*	*37*	*12.374582*
7.858413	*25*	*62*	*20.735786*
11.113474	*70*	*132*	*44.147157*
15.716825	*41*	*173*	*57.859532*
22.226947	*50*	*223*	*74.581940*
31.433650	*76*	*299*	*100.000000*

Gradation Result Parameters

Gradation Result Parameters

D5: 3.1556 in

D15: 6.2795 in

D50: 13.0783 in

D85: 26.0005 in

D100: 31.4337 in

Image Gradation Input Parameters

Name: DSCF0232

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0232.JPG

- *Scale Line Length: 24 in*
- *Median Filter Radius: 2 px*
- *Background Subtraction Radius: 3 px*
- *Advanced Controls:*
  - *Automate Threshold Selection*
  - *Threshold Value: 219*
  - *Morphologic Iterations: 1*
  - *Resolution: 35 %*
  - *Flood Depth: 0.9 px*

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.051303	0	0	0.000000
0.072553	0	0	0.000000
0.102606	0	0	0.000000
0.145107	1	1	0.051020
0.205212	5	6	0.306122
0.290213	9	15	0.765306
0.410423	19	34	1.734694
0.580426	36	70	3.571429
0.820847	73	143	7.295918
1.160852	89	232	11.836735
1.641693	137	369	18.826531
2.321705	199	568	28.979592
3.283386	326	894	45.612245
4.643409	323	1217	62.091837
6.566772	461	1678	85.612245
9.286818	0	1678	85.612245
13.133544	282	1960	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.6726 in

D15: 1.3785 in

D50: 3.6455 in

D85: 6.5167 in

D100: 13.1335 in

Image Gradation Input Parameters

Name: DSCF0233

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0233.JPG

- *Scale Line Length: 24 in*
- *Median Filter Radius: 2 px*
- *Background Subtraction Radius: 3 px*
- *Advanced Controls:*
  - *Automate Threshold Selection*
  - *Threshold Value: 202*
  - *Morphologic Iterations: 1*
  - *Resolution: 38 %*
  - *Flood Depth: 0.9 px*

Gradation Results

Particle Size in	*Particle count*	*Cumulative Particle count*	*Cumulative Percent Finer (%)*
0.067951	0	0	0.000000
0.096097	0	0	0.000000
0.135902	0	0	0.000000
0.192194	0	0	0.000000
0.271804	0	0	0.000000
0.384388	1	1	0.126904
0.543607	2	3	0.380711
0.768776	4	7	0.888325
1.087214	8	15	1.903553
1.537553	19	34	4.314721
2.174428	32	66	8.375635
3.075106	50	116	14.720812
4.348856	55	171	21.700508
6.150211	60	231	29.314721
8.697712	97	328	41.624365
12.300423	114	442	56.091371
17.395425	136	578	73.350254
24.600846	210	788	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.6450 in

D15: 3.1261 in

D50: 10.7835 in

D85: 20.5452 in

D100: 24.6008 in

Image Gradation Input Parameters

Name: DSCF0234

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0234.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 197

Morphologic Iterations: 1

Resolution: 34 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	*Particle count*	*Cumulative Particle count*	*Cumulative Percent Finer (%)*
0.050554	*0*	*0*	*0.000000*
0.071494	*0*	*0*	*0.000000*
0.101107	*0*	*0*	*0.000000*
0.142987	*0*	*0*	*0.000000*
0.202215	*0*	*0*	*0.000000*
0.285975	*0*	*0*	*0.000000*
0.404429	*2*	*2*	*0.229358*
0.571949	*2*	*4*	*0.458716*
0.808859	*7*	*11*	*1.261468*
1.143899	*14*	*25*	*2.866972*
1.617717	*27*	*52*	*5.963303*
2.287797	*39*	*91*	*10.435780*
3.235434	*68*	*159*	*18.233945*
4.575595	*89*	*248*	*28.440367*
6.470868	*66*	*314*	*36.009174*
9.151190	*31*	*345*	*39.564220*
12.941737	*75*	*420*	*48.165138*
18.302380	*178*	*598*	*68.577982*
25.883474	*274*	*872*	*100.000000*

Results of the sediment size analysis for the sediment samples collected from Gunnison River channel during the site visit are tabulated and plotted below.

Figure G.14.1.
Photo of sediment sample 1 collected at the Gunnison River near the vicinity of J-09-AB

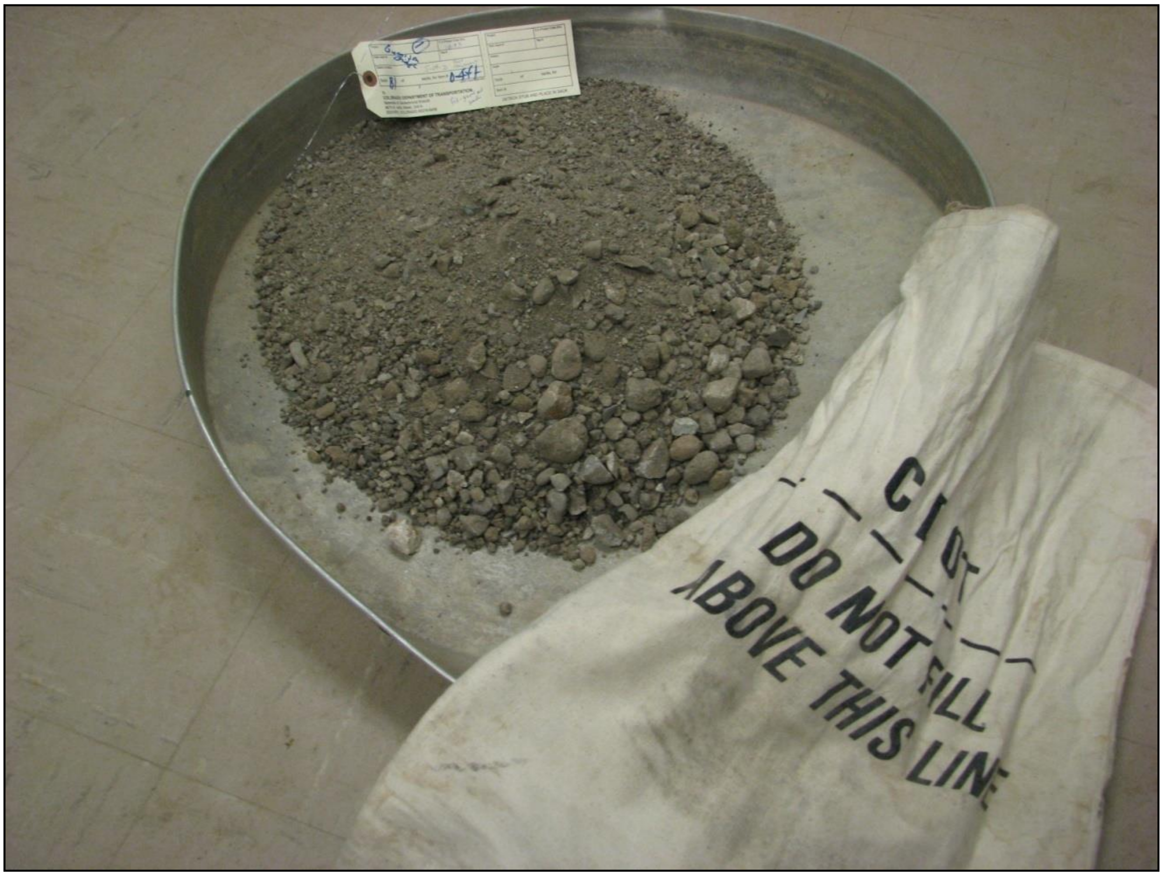


Table G.14.1.
Sediment Size Analysis
Sample ID: J-09-AB Gunnison River
Sample Description: 1 of 4
Performed by: AP
Date: 2-14-2011

Sieve Size (mm)	% Finer
50	100%
44.45	100%
22.4	98%
11.5	84%
8	76%
4.75	66%
2	55%
1	42%
0.5	30%
0.25	15%
0.125	8%
0.075	5%

Figure G.14.2.
Grain size gradation curve for sediment sample 1 collected in the vicinity of J-09-AB

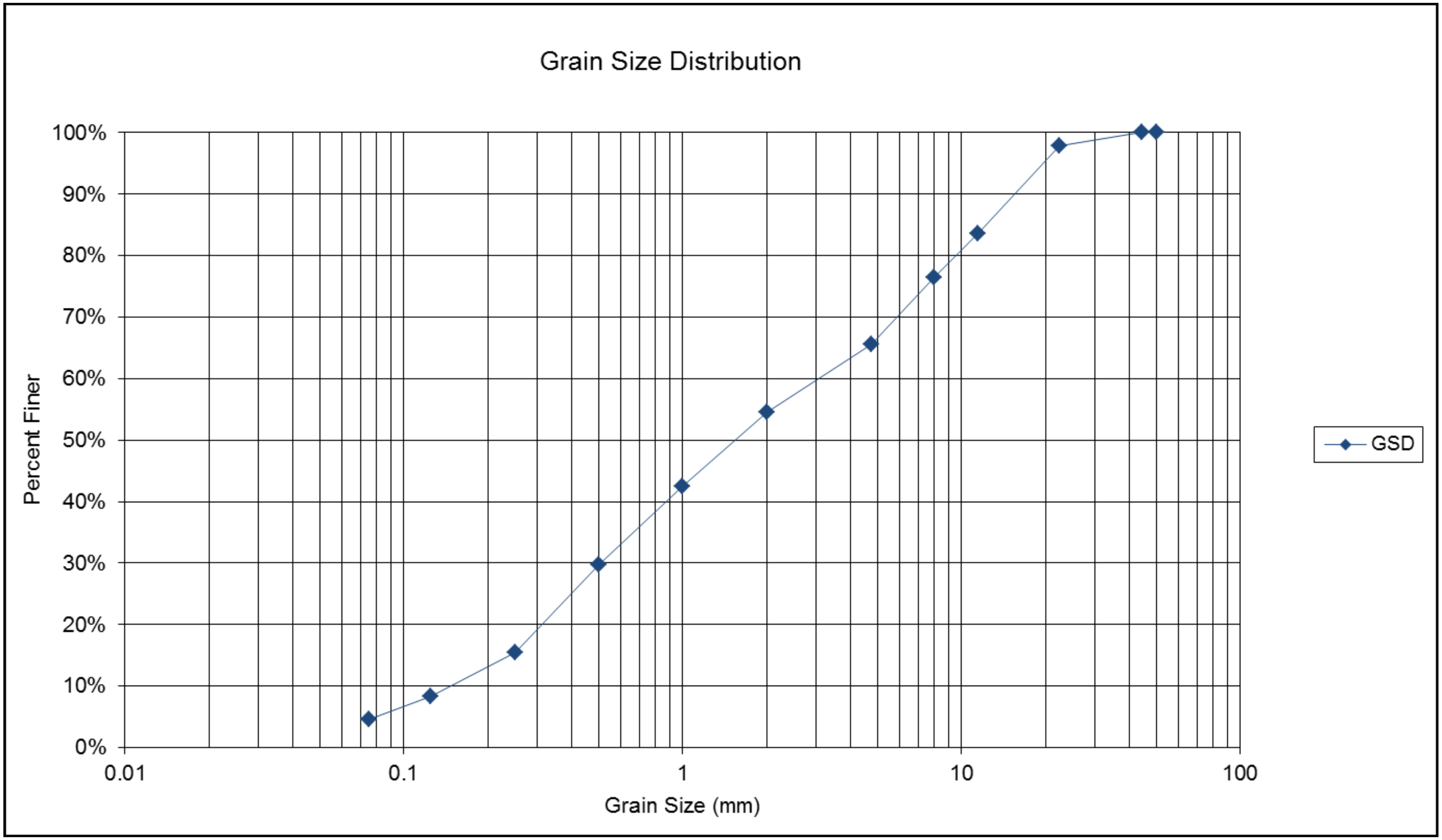


Table G.14.2.

Grain size gradation computations for sediment sample 1 collected in the vicinity of J-09-AB

Structure # J-09-AB	**Waterbody-Gunnison 18, 93**	**Grab Sample # 1 of 4**	**ID - East Abutment**	**Item # 0 - 4 ft.**	Performed by: AP	
			Fill - Gravel and sand	**Sack - B1**	Date: 2-14-2011	
Sieve Size (mm)	Weight of Sieve (g)	Weight of Sieve + Soil (g)	Weight of Soil (g)	% Retained	Cumulative % Ret.	% Finer
50			0	0%	0%	100%
44.45	560.47	560.47	0	0%	0%	100%
22.4	531.12	626.03	94.91	2%	2%	98%
11.5	552.37	1187.9	635.53	14%	16%	84%
8	527.02	850.55	323.53	7%	24%	76%
4.75	506.93	988.03	481.1	11%	34%	66%
2	430.31	927.8	497.49	11%	45%	55%
1	451.76	991.47	539.71	12%	58%	42%
0.5	441.62	1011.6	569.98	13%	70%	30%
0.25	395.98	1033.6	637.62	14%	85%	15%
0.125	366.92	684.77	317.85	7%	92%	8%
0.075	305.07	467.06	161.99	4%	95%	5%
Pan	372.91	580.47	207.56	5%	100%	0%
		Total Weight of Sample	**4467.27**			

Figure G.14.3.
Photo of sediment sample 2 collected from the Gunnison River near the vicinity of J-09-AB

Table G.14.3.
Sediment Size Analysis
Sample ID: J-09-AB Gunnison River
Sample Description: 2 of 4
Performed by: AP and TL
Date: 2-15-2011

Sieve Size (mm)	% Finer
50	100%
44.45	100%
22.4	22%
11.5	11%
8	10%
4.75	9%
2	7%
1	5%
0.5	4%
0.25	2%
0.125	1%
0.075	1%

Figure G.14.4.
Grain size gradation curve for sediment sample 2 collected in the vicinity of J-09-AB

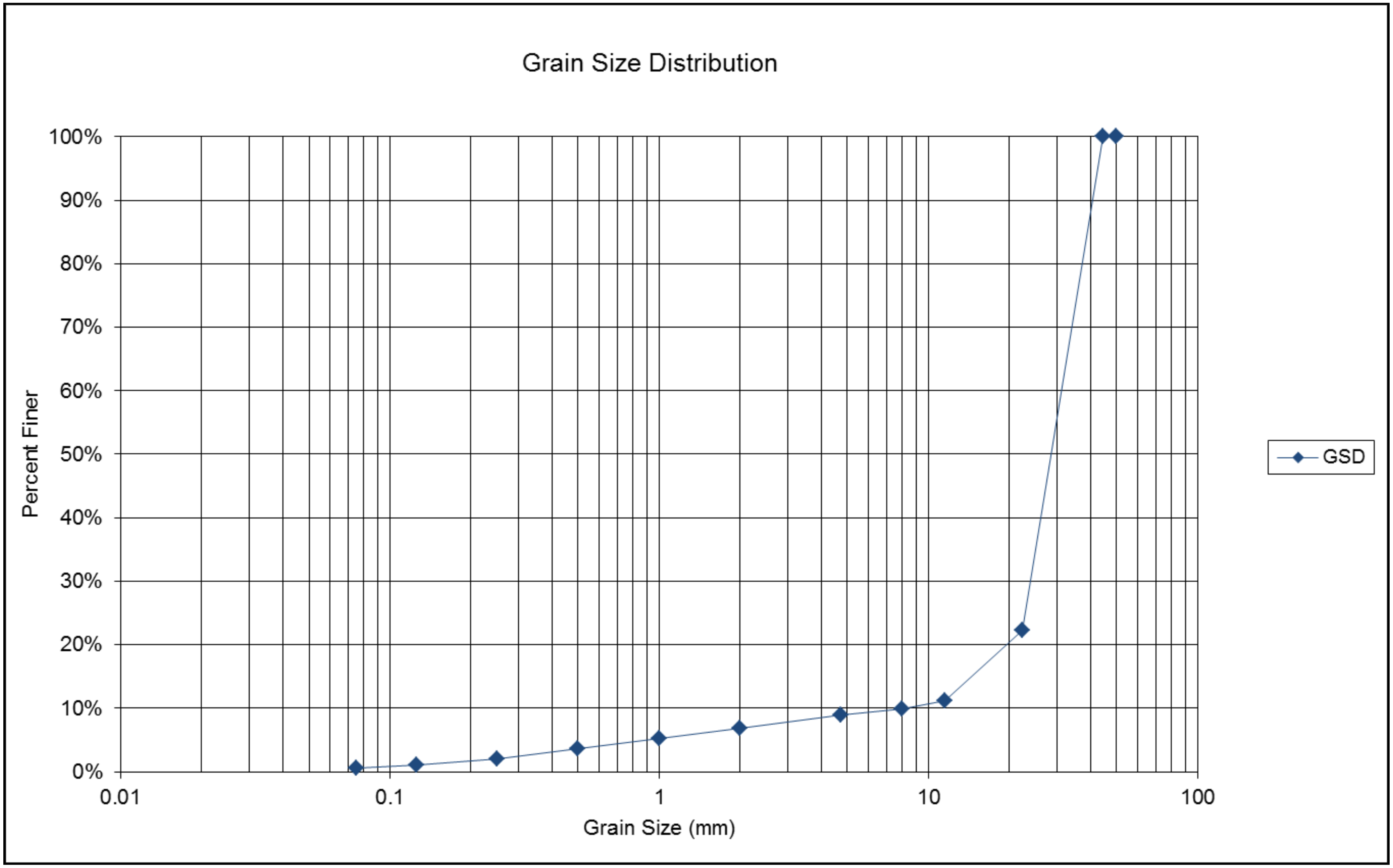


Table G.14.4.

Grain size gradation computations for sediment sample 2 collected in the vicinity of J-09-AB

Structure # J-09-AB	**Waterbody-Gunnison 18, 93**	**Grab Sample # 2 of 4**	**ID - East Abutment** **Fill - Cobbles, 1 - 9" diam.**	**Item # 4 - 9 ft.** **Sack - B1**	Performed by: AP and TL Date: 2-15-2011	
Sieve Size (mm)	Weight of Sieve (g)	Weight of Sieve + Soil (g)	Weight of Soil (g)	% Retained	Cumulative % Ret.	% Finer
50			0	0%	0%	100%
44.45	560.47	1169.1	608.63	20%	20%	100%
22.4	531.12	2273.9	1742.78	58%	78%	22%
11.5	552.37	887.59	335.22	11%	89%	11%
8	527.02	568.54	41.52	1%	90%	10%
4.75	506.93	537.75	30.82	1%	91%	9%
2	430.31	493.44	63.13	2%	93%	7%
1	451.76	495.89	44.13	1%	95%	5%
0.5	441.62	494.28	52.66	2%	96%	4%
0.25	395.98	440.97	44.99	1%	98%	2%
0.125	366.92	396	29.08	1%	99%	1%
0.075	305.07	319.29	14.22	0%	99%	1%
Pan	372.91	392.51	19.6	1%	100%	0%
		Total Weight of Sample	**3026.78**			

Figure G.14.5.
Photo of sediment sample 3 collected from the Gunnison River in the vicinity of J-09-AB

Table G.14.5.
Sediment Size Analysis
Sample ID: J-09-AB Gunnison River
Sample Description: 3 of 4
Performed by: AP and TL
Date: 2-15-2011

Sieve Size (mm)	% Finer
50	100%
44.45	100%
22.4	49%
8	11%
4.75	6%
2	5%
1	4%
0.5	2%
0.25	2%
0.125	1%
0.075	1%

Figure G.14.6.
Grain size gradation curve for sediment sample 3 collected in the vicinity of J-09-AB

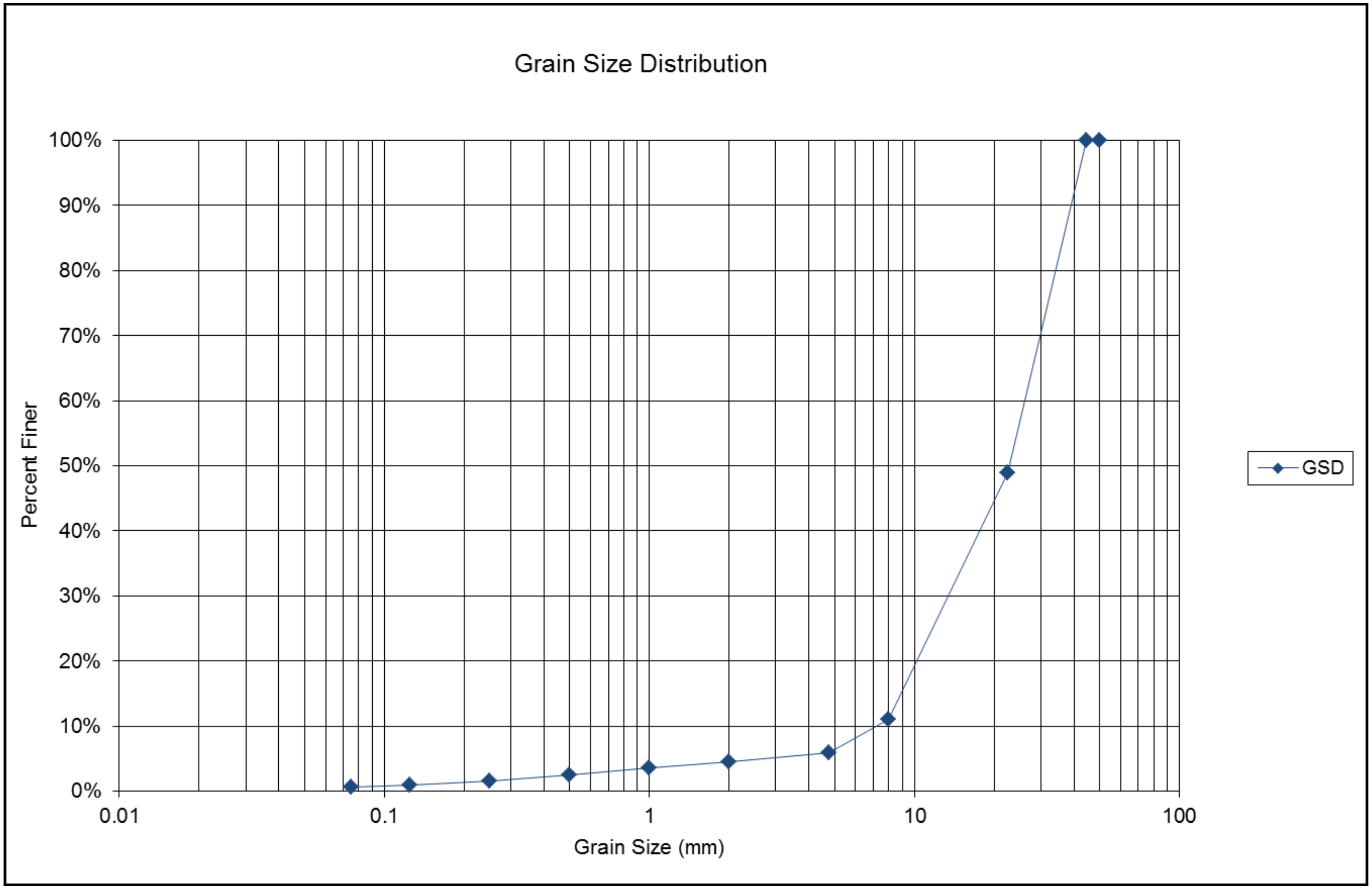


Table G.14.6.
Grain size gradation computations for sediment sample 3 collected near the vicinity of J-09-AB

Structure # J-09-AB	**Waterbody- Gunnison 18, 93**	**Grab Sample # 3 of 4**	**ID - East Abutment**	**Item # 10 - 14 ft.** / **Sack - B1**	Performed by: AP and TL / Date: 2-15-2011	
Sieve Size (mm)	Weight of Sieve (g)	Weight of Sieve + Soil (g)	Weight of Soil (g)	% Retained	Cumulative % Ret.	% Finer
50			0	0%	0%	100%
44.45	560.47	1189.5	629.03	9%	9%	100%
22.4	531.12	3440.7	2909.58	42%	51%	49%
8	527.02	3156.42	2629.4	38%	89%	11%
4.75	506.93	861.8	354.87	5%	94%	6%
2	430.31	523.43	93.12	1%	95%	5%
1	451.76	518.6	66.84	1%	96%	4%
0.5	441.62	517	75.38	1%	98%	2%
0.25	395.98	459.64	63.66	1%	98%	2%
0.125	366.92	408.36	41.44	1%	99%	1%
0.075	305.07	326.51	21.44	0%	99%	1%
Pan	372.91	417.32	44.41	1%	100%	0%
		Total Weight of Sample	**6929.17**			

Figure G.14.7.

Photo of sediment sample 4 collected at the Gunnison River near the vicinity of J-09-AB

Table G.14.7.
Sediment Size Analysis
Sample ID: J-09-AB Gunnison River
Sample Description: 4 of 4
Performed by: AP and TL
Date: 2-15-2011

Sieve Size (mm)	% Finer
72	100%
64	100%
44.45	100%
22.4	48%
11.5	30%
8	25%
4.75	21%
2	18%
1	14%
0.5	11%
0.25	8%
0.125	5%
0.075	3%

Figure G.14.8.
Grain size gradation curve for sediment sample 4 collected in the vicinity of J-09-AB

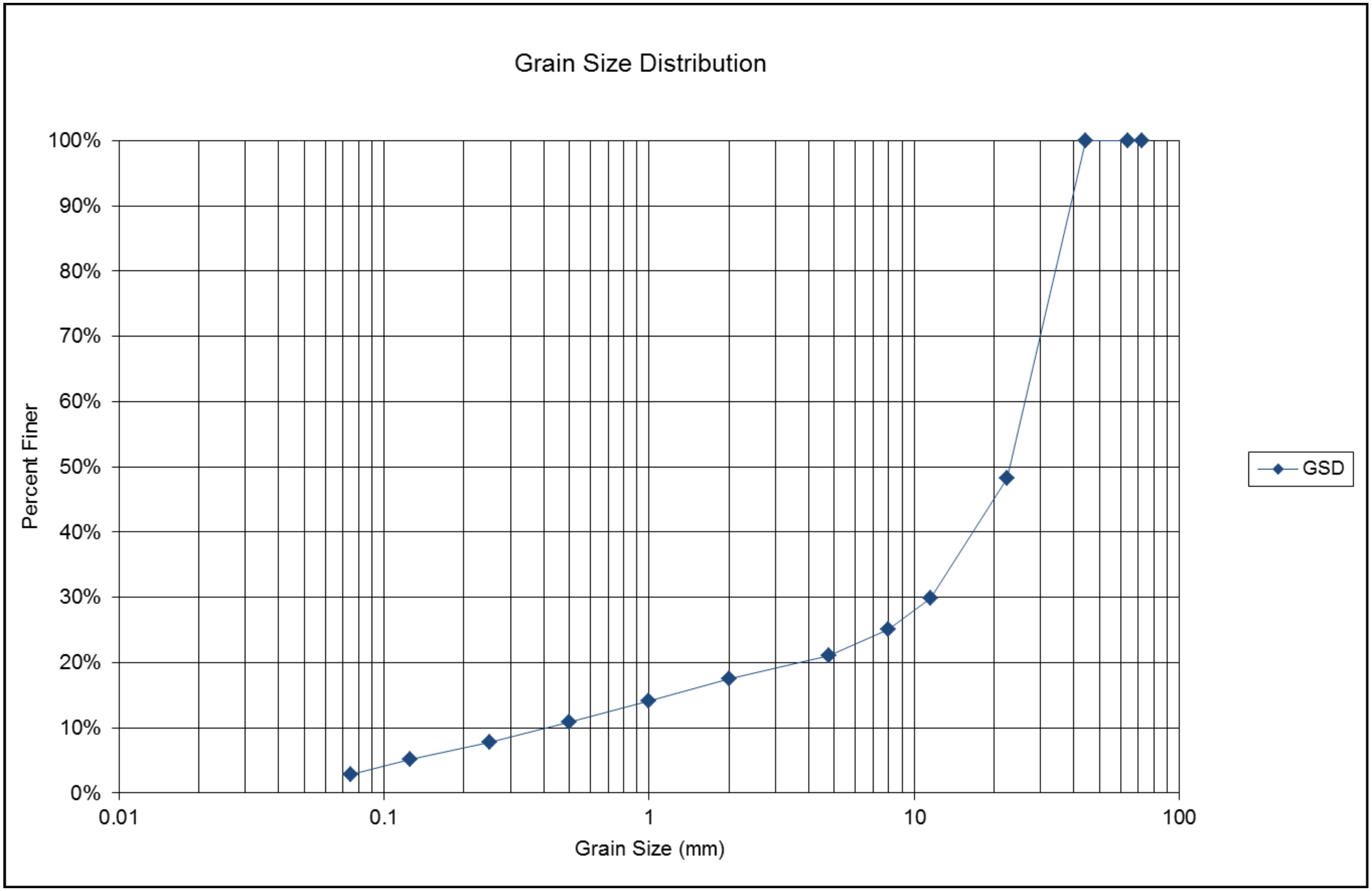


Table G.14.8.

Grain size gradation computations for sediment sample 4 collected in the vicinity of J-09-AB

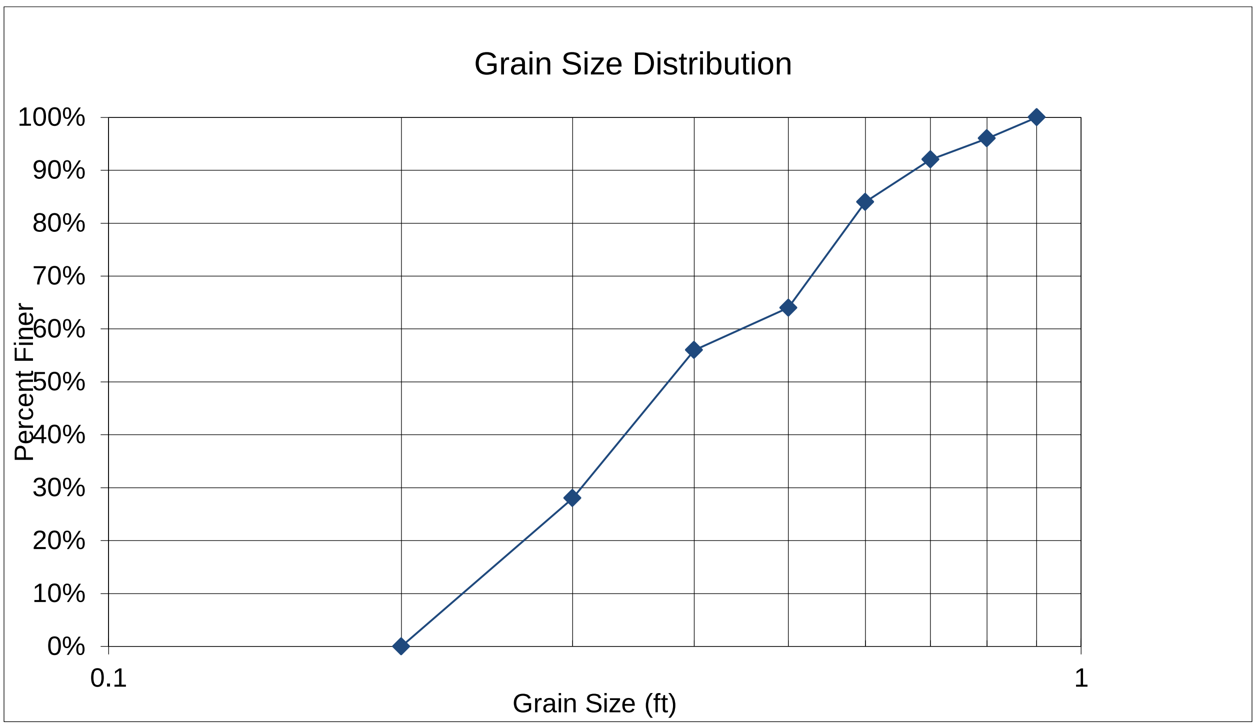
Structure # J-09-AB	**Waterbody- Gunnison 18, 93**	**Grab Sample # 4 of 4**	**ID - East Abutment** **Fill - Cobbles, 1 - 5" diam**	**Item # 15 - 18 ft.** **Sack - B1**	Performed by: AP and TL Date: 2-15-2011	
Sieve Size (mm)	Weight of Sieve (g)	Weight of Sieve + Soil (g)	Weight of Soil (g)	% Retained	Cumulative % Ret.	% Finer
72			0	0	0	100%
64			596.21	4%	4%	100%
44.45	560.47	1169.1	2311.4	17%	21%	100%
22.4	531.12	2273.9	4233.67	31%	52%	48%
11.5	552.37	887.59	2543.2	18%	70%	30%
8	527.02	568.54	669.93	5%	75%	25%
4.75	506.93	537.75	551.36	4%	79%	21%
2	430.31	493.44	477.42	3%	82%	18%
1	451.76	495.89	467.06	3%	86%	14%
0.5	441.62	494.28	459.02	3%	89%	11%
0.25	395.98	440.97	414.18	3%	92%	8%
0.125	366.92	396	380.23	3%	95%	5%
0.075	305.07	319.29	313.13	2%	97%	3%
Pan	372.91	392.51	388.86	3%	100%	0%
		Total Weight of Sample	**13805.67**			

Pebble Count Grain Size Distribution

Region	Structure ID	County	Facility Carried	Mile Marker	POA Fiscal Year	Feature Intersected	D_{50} min from POA	D_{50} max from POA
3	J-09-AB	Gunnison	US 50 ML	155.6	2011	Gunnison River	1.5	29

Sample #	A (ft)	B (ft)	C (ft)	Shape Factor	D_s (ft)	D_{avg} (ft)	Volume (ft³)
1	0.4	0.29	0.17	0.499	0.29	0.287	0.010
2	0.28	0.24	0.22	0.849	0.24	0.247	0.008
3	0.56	0.44	0.37	0.745	0.44	0.457	0.048
4	0.1	0.45	0.35	1.650	0.45	0.300	0.008
5	0.69	0.38	0.34	0.664	0.38	0.470	0.047
6	0.55	0.38	0.24	0.525	0.38	0.390	0.026
7	0.35	0.31	0.22	0.668	0.31	0.293	0.012
8	0.41	0.35	0.25	0.660	0.35	0.337	0.019
9	0.74	0.69	0.23	0.322	0.69	0.553	0.061
10	0.64	0.5	0.35	0.619	0.5	0.497	0.059
11	0.37	0.3	0.22	0.660	0.3	0.297	0.013
12	0.65	0.53	0.41	0.699	0.53	0.530	0.074
13	0.35	0.25	0.11	0.372	0.25	0.237	0.005
14	0.65	0.54	0.19	0.321	0.54	0.460	0.035
15	0.99	0.7	0.55	0.661	0.7	0.747	0.200
16	0.48	0.38	0.17	0.398	0.38	0.343	0.016
17	0.66	0.54	0.22	0.369	0.54	0.473	0.041
18	0.9	0.62	0.35	0.469	0.62	0.623	0.102
19	0.39	0.2	0.18	0.645	0.2	0.257	0.007
20	0.28	0.23	0.1	0.394	0.23	0.203	0.003
21	0.6	0.51	0.4	0.723	0.51	0.503	0.064
22	0.8	0.8	0.38	0.475	0.8	0.660	0.127
23	0.43	0.34	0.17	0.445	0.34	0.313	0.013
24	0.25	0.23	0.15	0.626	0.23	0.210	0.005
25	0.45	0.28	0.28	0.789	0.28	0.337	0.018

Structure # J-09-AB	Gunnison River at US 50			
Sieve Size (ft)	Samples Retained	% Retained	Cumulative % Ret.	% Finer
0.9	0	0%	0%	100%
0.8	1	4%	4%	96%
0.7	1	4%	8%	92%
0.6	2	8%	16%	84%
0.5	5	20%	36%	64%
0.4	2	8%	44%	56%
0.3	7	28%	72%	28%
0.2	7	28%	100%	0%
Total Samples	25			



Two sediment samples were collected from the channel bed near Bridge K-08-D. Results of the sediment size analysis for the sediment sample collected from the channel are presented below in both tabular and graphical formats.

Figure G.15.1.
Photo of sediment sample from the K-08-D site

Table G.15.1.
Sediment sieve analysis
Sample ID: K-08-D Cebolla Creek
Sample Description: 1 of 2
Performed by: JE
Date: 9-11-2012

Sieve Size (mm)	% Finer
44.45	100%
16	65%
8	51%
4	49%
2	30%
1	19%
0.5	8%
0.25	3%

Figure G.15.2.
Grain size gradation curve for the sediment sample collected from Cebolla Creek in the vicinity of K-08-D

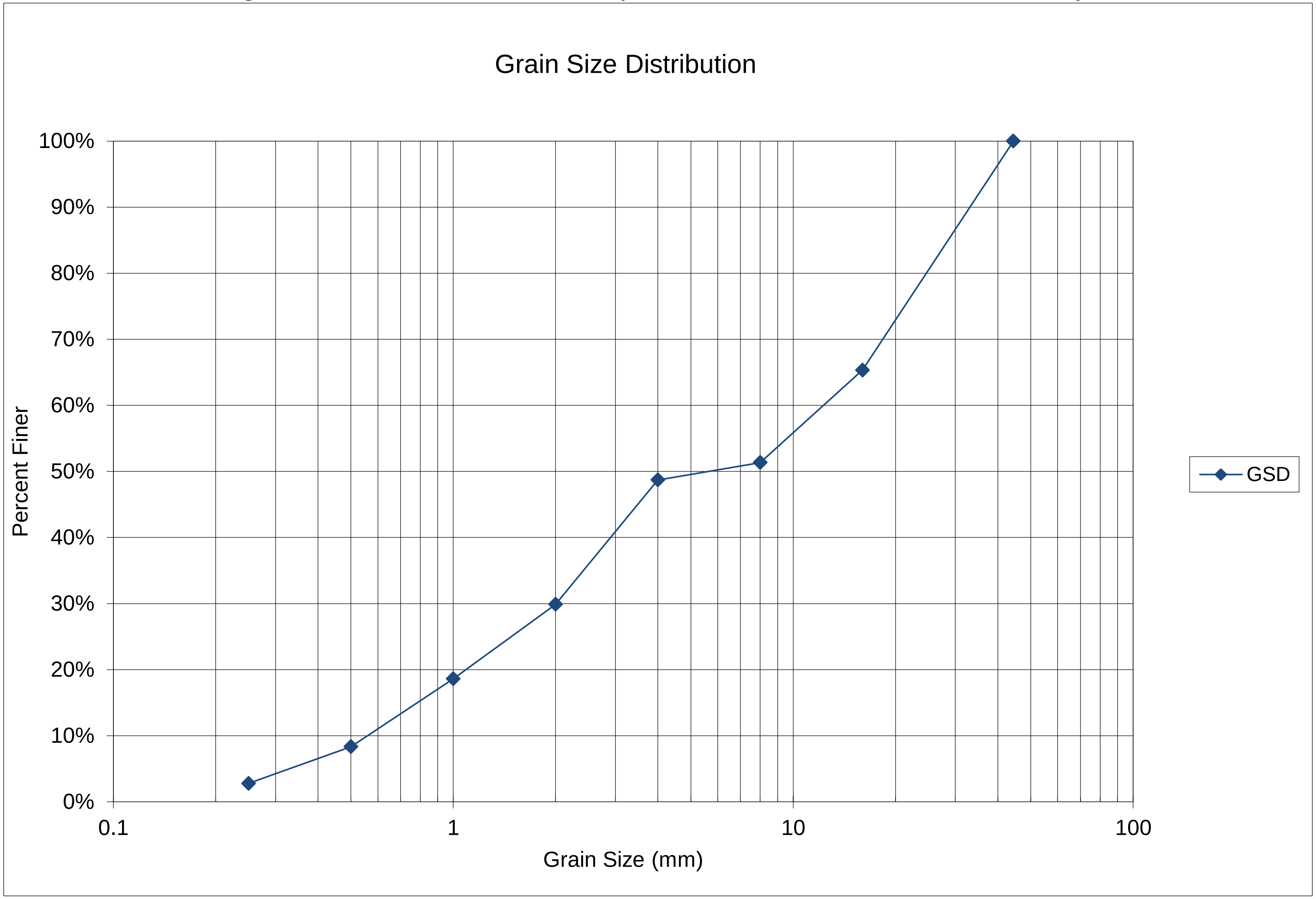


Table G.15.2.

Grain size gradation computations for the sediment sample collected from Cebolla Creek in the vicinity of K-08-D

Structure # K-08-D	**Waterbody - Cebolla Creek**	**Sample # 1 of 2**	Performed by: JE Date: 9/11/2012			
Sieve Size (mm)	Weight of Sieve (g)	Weight of Sieve + Soil (g)	Weight of Soil (g)	% Retained	Cumulative % Ret.	% Finer
44.45	0	0	0	0%	0%	100%
16	555.5	1456.3	900.8	35%	35%	65%
8	525.51	889.01	363.5	14%	49%	51%
4	491.59	559.91	68.32	3%	51%	49%
2	479.61	968.98	489.37	19%	70%	30%
1	500.31	793.4	293.09	11%	81%	19%
0.5	441.02	707.93	266.91	10%	92%	8%
0.25	392.91	537.39	144.48	6%	97%	3%
Pan	371.72	443.81	72.09	3%	100%	0%
		Total Weight of Sample	**2598.56**			

Figure G.15.3.
Photo of sediment sample from the K-08-D site

Table G.15.3.
Sediment sieve analysis
Sample ID: K-08-D Cebolla Creek
Sample Description: 2 of 2
Performed by: JE
Date: 9-11-2012

Sieve Size (mm)	% Finer
44.45	100%
16	68%
8	40%
4	27%
2	21%
1	15%
0.5	8%
0.25	2%

Figure G.15.4.
Grain size gradation curve for the sediment sample collected from Cebolla Creek in the vicinity of K-08-D

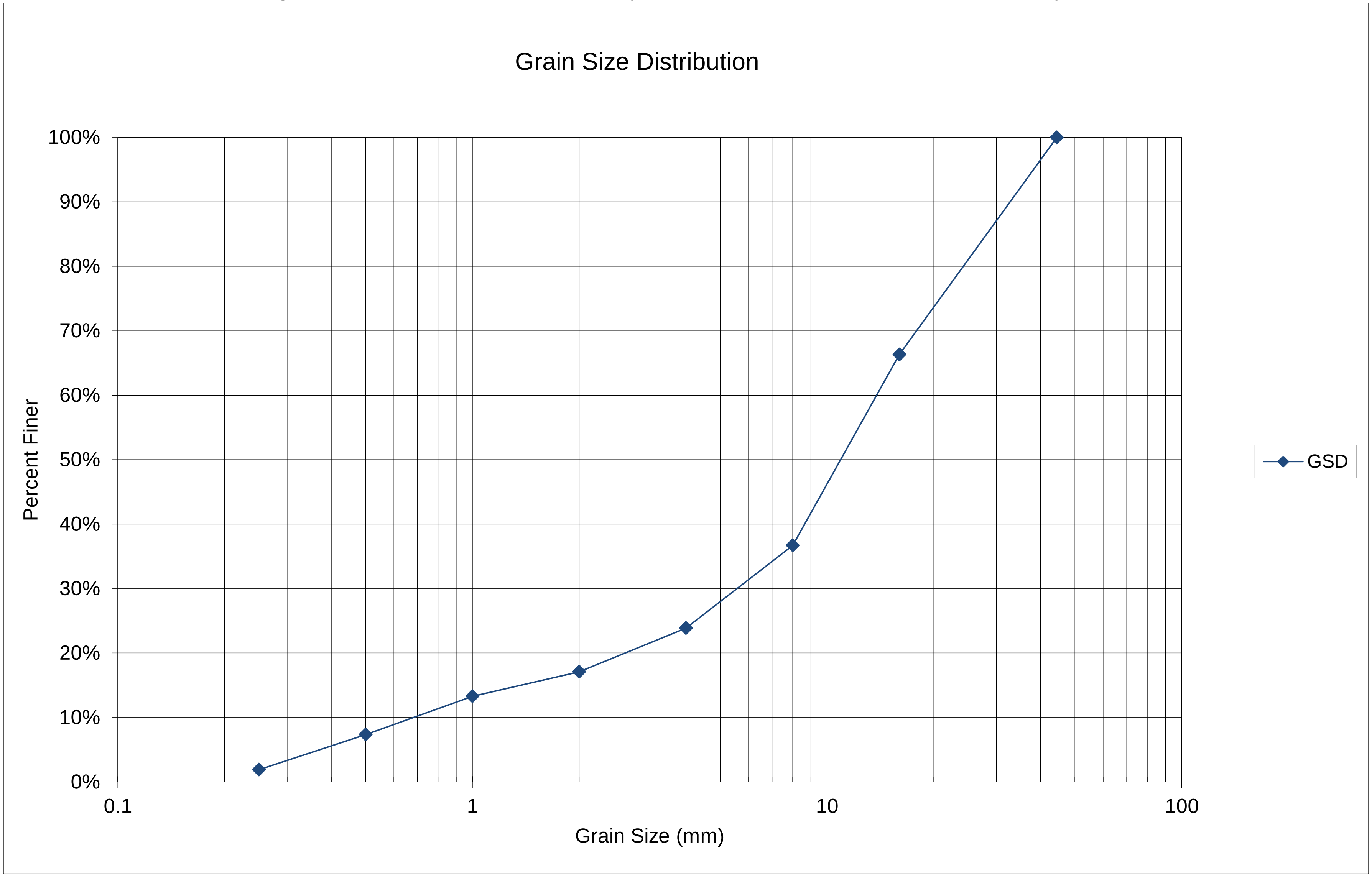


Table G.15.4.

Grain size gradation computations for the sediment sample collected from Cebolla Creek in the vicinity of K-08-D

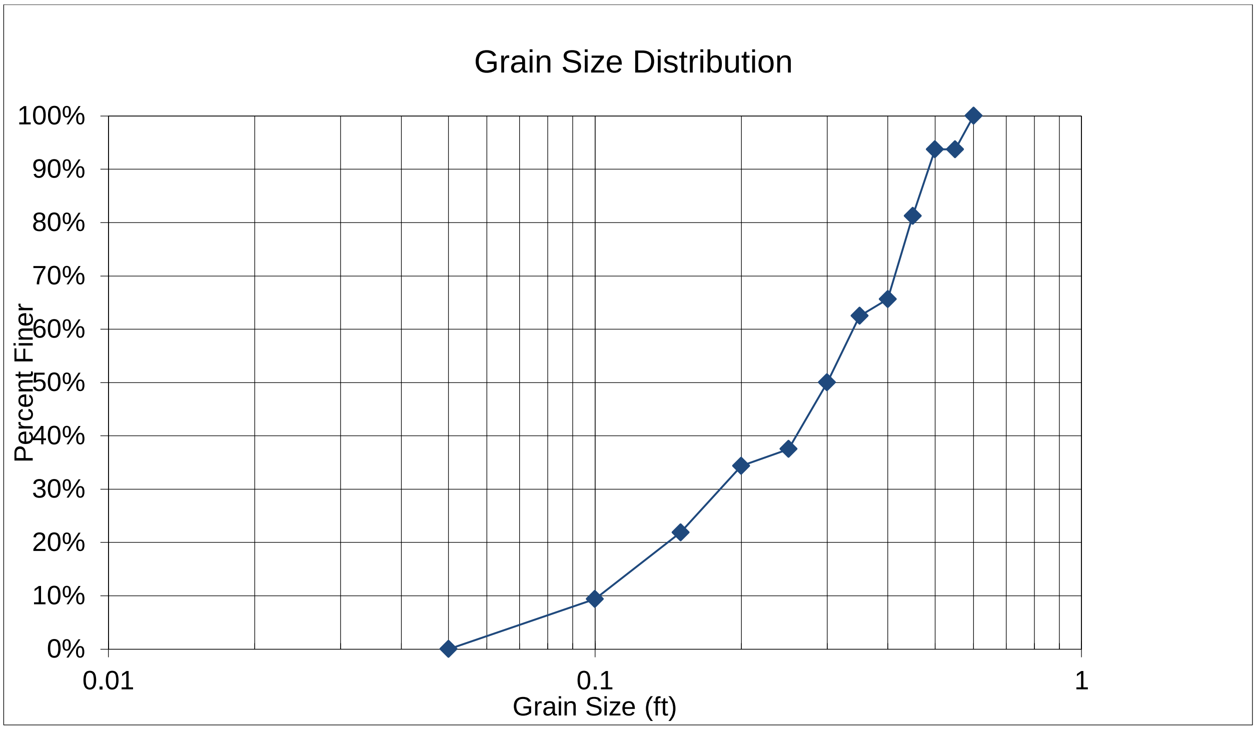
Structure # K-08-D	**Waterbody - Cebolla Creek**	**Sample # 2 of 2**	Performed by: JE			
			Date: 9/11/2012			
Sieve Size (mm)	Weight of Sieve (g)	Weight of Sieve + Soil (g)	Weight of Soil (g)	% Retained	Cumulative % Ret.	% Finer
44.45	0	0	0	0%	0%	100%
16	555.5	1342.1	786.6	34%	34%	66%
8	525.51	1218.3	692.79	30%	63%	37%
4	491.59	791	299.41	13%	76%	24%
2	479.61	638.04	158.43	7%	83%	17%
1	500.31	589.49	89.18	4%	87%	13%
0.5	441.02	579.46	138.44	6%	93%	7%
0.25	392.91	520.07	127.16	5%	98%	2%
Pan	371.72	416.45	44.73	2%	100%	0%
		Total Weight of Sample	**2336.74**			

Pebble Count Grain Size Distribution

Region	Structure ID	County	Facility Carried	Mile Marker	POA Fiscal Year	Feature Intersected	D_{50} min from POA	D_{50} max from POA	Date
3	K-08-D	Gunnison	SH149 ML	100.4	2013	Cebolla Creek	6	12	8/8/2013

Sample #	A (ft)	B (ft)	C (ft)	Shape Factor	D_s (ft)	D_{avg} (ft)	Volume (ft^3)
1	0.42	0.35	0.25	0.652	0.35	0.340	0.019
2	0.53	0.55	0.16	0.296	0.55	0.413	0.024
3	0.8	0.41	0.15	0.262	0.41	0.453	0.026
4	0.21	0.13	0.1	0.605	0.13	0.147	0.001
5	0.08	0.05	0.03	0.474	0.05	0.053	0.000
6	0.46	0.3	0.24	0.646	0.3	0.333	0.017
7	0.18	0.15	0.07	0.426	0.15	0.133	0.001
8	0.11	0.08	0.03	0.320	0.08	0.073	0.000
9	0.38	0.3	0.19	0.563	0.3	0.290	0.011
10	0.17	0.16	0.09	0.546	0.16	0.140	0.001
11	0.51	0.4	0.29	0.642	0.4	0.400	0.031
12	0.63	0.42	0.29	0.564	0.42	0.447	0.040
13	0.29	0.21	0.13	0.527	0.21	0.210	0.004
14	0.75	0.33	0.27	0.543	0.33	0.450	0.035
15	0.3	0.19	0.13	0.545	0.19	0.207	0.004
16	0.4	0.25	0.16	0.506	0.25	0.270	0.008
17	0.53	0.4	0.2	0.434	0.4	0.377	0.022
18	0.28	0.18	0.08	0.356	0.18	0.180	0.002
19	0.41	0.27	0.15	0.451	0.27	0.277	0.009
20	0.31	0.27	0.14	0.484	0.27	0.240	0.006
21	0.08	0.06	0.4	5.774	0.06	0.180	0.001
22	0.71	0.55	0.5	0.800	0.55	0.587	0.102
23	0.2	0.11	0.08	0.539	0.11	0.130	0.001
24	0.36	0.26	0.01	0.033	0.26	0.210	0.000
25	0.55	0.45	0.18	0.362	0.45	0.393	0.023
26	0.56	0.45	0.36	0.717	0.45	0.457	0.048
27	0.43	0.43	0.3	0.698	0.43	0.387	0.029
28	0.14	0.13	0.04	0.296	0.13	0.103	0.000
29	0.66	0.48	0.02	0.036	0.48	0.387	0.003
30	0.4	0.3	0.23	0.664	0.3	0.310	0.014
31	0.14	0.13	0.05	0.371	0.13	0.107	0.000
32	0.55	0.48	0.32	0.623	0.48	0.450	0.044

Structure # K-08-D	Cebolla Creek at SH 149			
Sieve Size (ft)	Samples Retained	% Retained	Cumulative % Ret.	% Finer
0.6	0	0%	0%	100%
0.55	2	6%	6%	94%
0.5	0	0%	6%	94%
0.45	4	13%	19%	81%
0.4	5	16%	34%	66%
0.35	1	3%	38%	63%
0.3	4	13%	50%	50%
0.25	4	13%	63%	38%
0.2	1	3%	66%	34%
0.15	4	13%	78%	22%
0.1	4	13%	91%	9%
0.05	3	9%	100%	0%
Pan	0	0%	100%	0%
Total Samples	32			



Hydraulic Analysis Report

Project Data

Project Title: K-08-D

Designer:

Project Date: Thursday, September 26, 2013

Project Units: U.S. Customary Units

Notes:

Wolman Count Analysis: Hydraulic Toolbox GSD

Notes:

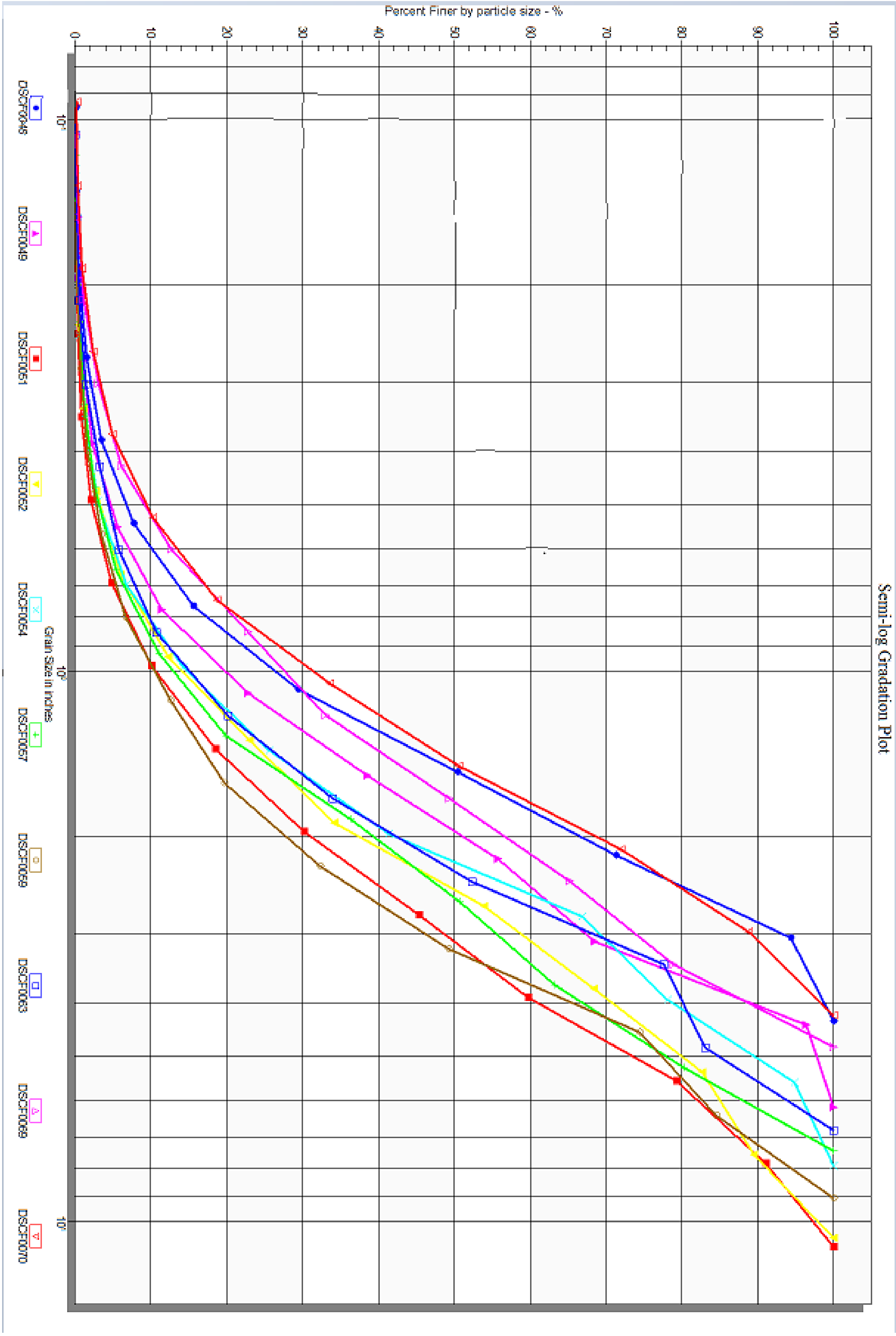

Semi-log Gradation Plot
Percent Finer by particle size - %
0
10
20
30
40
50
60
70
80
90
100
10^{-1}
10^{0}
10^{1}
Grain Size in inches
DSCF0046
DSCF0049
DSCF0051
DSCF0052
DSCF0054
DSCF0057
DSCF0059
DSCF0063
DSCF0069
DSCF0070

Image Gradation Input Parameters

Name: DSCF0048

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0048.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 202

Morphologic Iterations: 1

Resolution: 29 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.042023	0	0	0.000000
0.059429	0	0	0.000000
0.084046	0	0	0.000000
0.118859	2	2	0.087451
0.168092	7	9	0.393529
0.237718	18	27	1.180586
0.336184	38	65	2.842151
0.475436	81	146	6.383909
0.672368	147	293	12.811544
0.950872	272	565	24.704854
1.344736	439	1004	43.900306
1.901744	568	1572	68.736336
2.689472	479	2051	89.680805
3.803487	236	2287	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.4210 in

D15: 0.7236 in

D50: 1.4815 in

D85: 2.5134 in

D100: 3.8035 in

Image Gradation Input Parameters

Name: DSCF0049

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0049.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 199

Morphologic Iterations: 1

Resolution: 30 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.034124	0	0	0.000000
0.048259	0	0	0.000000
0.068248	0	0	0.000000
0.096518	0	0	0.000000
0.136497	2	2	0.099354
0.193036	5	7	0.347740
0.272994	13	20	0.993542
0.386072	26	46	2.285147
0.545988	66	112	5.563835
0.772143	117	229	11.376056
1.091975	229	458	22.752111
1.544286	317	775	38.499752
2.183951	348	1123	55.787382
3.088573	256	1379	68.504719
4.367902	561	1940	96.373572
6.177146	73	2013	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.5185 in

D15: 0.8740 in

D50: 1.9698 in

D85: 3.8458 in

D100: 6.1771 in

Image Gradation Input Parameters

Name: DSCF0051

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0051.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 192

Morphologic Iterations: 1

Resolution: 30 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.059611	0	0	0.000000
0.084303	0	0	0.000000
0.119222	0	0	0.000000
0.168606	1	1	0.058824
0.238445	4	5	0.294118
0.337212	9	14	0.823529
0.476889	20	34	2.000000
0.674423	46	80	4.705882
0.953779	80	160	9.411765
1.348847	159	319	18.764706
1.907557	217	536	31.529412
2.697694	223	759	44.647059
3.815115	273	1032	60.705882
5.395387	325	1357	79.823529
7.630230	193	1550	91.176471
10.790775	150	1700	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.6919 in

D15: 1.1898 in

D50: 3.0702 in

D85: 6.4144 in

D100: 10.7908 in

Image Gradation Input Parameters

Name: DSCF0052

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0052.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 195

Morphologic Iterations: 1

Resolution: 30 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.041380	0	0	0.000000
0.058520	0	0	0.000000
0.082760	0	0	0.000000
0.117040	0	0	0.000000
0.165520	2	2	0.106724
0.234080	6	8	0.426894
0.331040	12	20	1.067236
0.468161	31	51	2.721451
0.662079	66	117	6.243330
0.936322	115	232	12.379936
1.324159	175	407	21.718250
1.872643	227	634	33.831377
2.648317	372	1006	53.681964
3.745286	287	1293	68.996798
5.296635	263	1556	83.030950
7.490572	125	1681	89.701174
10.593269	193	1874	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.5936 in

D15: 1.0451 in

D50: 2.5044 in

D85: 5.9443 in

D100: 10.5933 in

Image Gradation Input Parameters

Name: DSCF0054

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0054.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 182

Morphologic Iterations: 1

Resolution: 30 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.043086	0	0	0.000000
0.060933	0	0	0.000000
0.086172	0	0	0.000000
0.121866	1	1	0.052247
0.172344	3	4	0.208986
0.243732	6	10	0.522466
0.344688	14	24	1.253918
0.487463	31	55	2.873563
0.689377	76	131	6.844305
0.974926	136	267	13.949843
1.378754	202	469	24.503657
1.949852	307	776	40.543365
2.757507	454	1230	64.263323
3.899704	211	1441	75.287356
5.515015	376	1817	94.932079
7.799409	97	1914	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.5956 in

D15: 1.0151 in

D50: 2.2718 in

D85: 4.6983 in

D100: 7.7994 in

Image Gradation Input Parameters

Name: DSCF0057

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0057.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 186

Morphologic Iterations: 1

Resolution: 33 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.028437	0	0	0.000000
0.040216	0	0	0.000000
0.056874	0	0	0.000000
0.080432	0	0	0.000000
0.113747	1	1	0.068634
0.160863	2	3	0.205903
0.227495	5	8	0.549073
0.321726	11	19	1.304049
0.454990	23	42	2.882636
0.643453	40	82	5.628003
0.909980	81	163	11.187371
1.286906	160	323	22.168840
1.819960	238	561	38.503775
2.573812	272	833	57.172272
3.639919	135	968	66.437886
5.147623	192	1160	79.615649
7.279839	297	1457	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.6003 in

D15: 1.0408 in

D50: 2.2842 in

D85: 5.7108 in

D100: 7.2798 in

Image Gradation Input Parameters

Name: DSCF0059

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0059.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 193

Morphologic Iterations: 1

Resolution: 33 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.030610	0	0	0.000000
0.043288	0	0	0.000000
0.061219	0	0	0.000000
0.086577	0	0	0.000000
0.122438	1	1	0.064020
0.173154	2	3	0.192061
0.244876	5	8	0.512164
0.346308	12	20	1.280410
0.489753	27	47	3.008963
0.692615	48	95	6.081946
0.979506	74	169	10.819462
1.385230	118	287	18.373880
1.959011	171	458	29.321383
2.770460	264	722	46.222791
3.918023	366	1088	69.654289
5.540921	186	1274	81.562100
7.836046	288	1562	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.6212 in

D15: 1.2040 in

D50: 2.9555 in

D85: 5.9689 in

D100: 7.8360 in

Image Gradation Input Parameters

Name: DSCF0063

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0063.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 183

Morphologic Iterations: 1

Resolution: 31 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.027888	0	0	0.000000
0.039440	0	0	0.000000
0.055776	0	0	0.000000
0.078879	0	0	0.000000
0.111552	1	1	0.075131
0.157758	3	4	0.300526
0.223104	6	10	0.751315
0.315516	13	23	1.728024
0.446208	29	52	3.906837
0.631033	44	96	7.212622
0.892415	88	184	13.824192
1.262066	122	306	22.990233
1.784831	193	499	37.490609
2.524132	331	830	62.359128
3.569661	225	1055	79.263711
5.048263	0	1055	79.263711
7.139323	276	1331	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.5073 in

D15: 0.9398 in

D50: 2.1567 in

D85: 5.6267 in

D100: 7.1393 in

Image Gradation Input Parameters

Name: DSCF0069

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0069.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 188

Morphologic Iterations: 1

Resolution: 30 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.025524	0	0	0.000000
0.036097	0	0	0.000000
0.051048	0	0	0.000000
0.072193	0	0	0.000000
0.102097	2	2	0.124766
0.144387	4	6	0.374298
0.204194	11	17	1.060512
0.288774	26	43	2.682470
0.408388	50	93	5.801622
0.577547	98	191	11.915159
0.816775	150	341	21.272614
1.155095	174	515	32.127261
1.633551	272	787	49.095446
2.310190	210	997	62.195883
3.267102	298	1295	80.786026
4.620380	308	1603	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.3776 in

D15: 0.6564 in

D50: 1.6803 in

D85: 3.5639 in

D100: 4.6204 in

Image Gradation Input Parameters

Name: DSCF0070

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0070.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 178

Morphologic Iterations: 1

Resolution: 31 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.033206	0	0	0.000000
0.046961	0	0	0.000000
0.066413	0	0	0.000000
0.093921	2	2	0.110193
0.132825	4	6	0.330579
0.187843	11	17	0.936639
0.265650	25	42	2.314050
0.375686	47	89	4.903581
0.531300	102	191	10.523416
0.751372	166	357	19.669421
1.062600	275	632	34.820937
1.502744	291	923	50.853994
2.125201	394	1317	72.561983
3.005488	223	1540	84.848485
4.250401	275	1815	100.000000

Two sediment samples were collected from the channel bed near Bridge L-07-A. Results of the sediment size analysis for the sediment sample collected from the channel are presented below in both tabular and graphical formats.

Figure G.16.1.
Photo of sediment sample from the L-07-A site

Table G.16.1.
Sediment sieve analysis
Sample ID: L-07-A Lake Fork Gunnison River
Sample Description: 1 of 2
Performed by: JE
Date: 9-11-2012

Sieve Size (mm)	% Finer
44.45	100%
8	93%
2	80%
1	70%
0.5	41%
0.25	14%
0.125	3%
0.063	1%

Figure G.16.2.

Grain size gradation curve for the sediment sample collected from Lake Fork Gunnison River in the vicinity of L-07-A

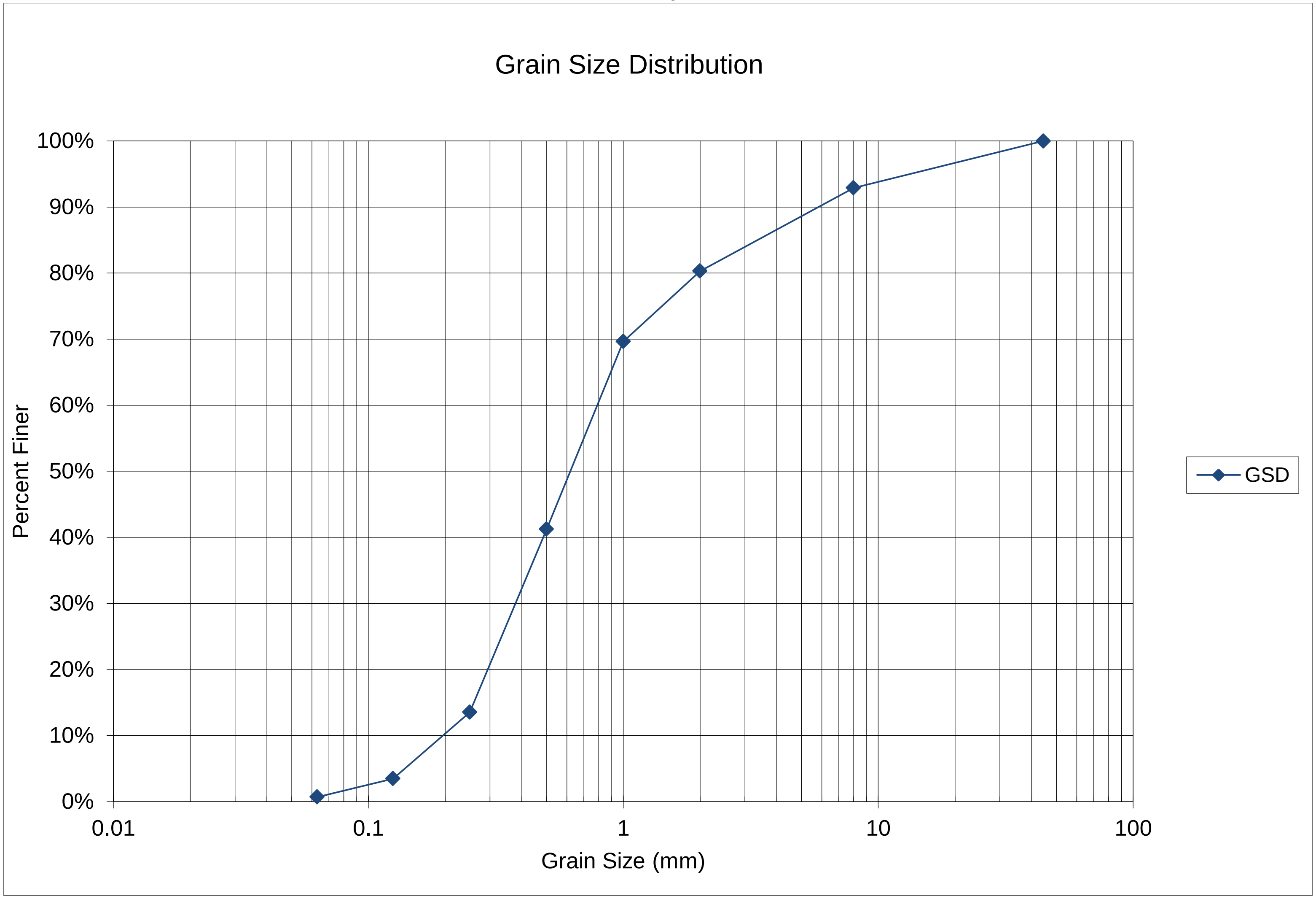


Table G.16.2.

Grain size gradation computations for the sediment sample collected from Lake Fork Gunnison River in the vicinity of L-07-A

Structure # L-07-A	**Waterbody - Lake Fork Gunnison River**	**Sample # 1 of 2**	Performed by: JE			
			Date: 9/11/2012			
Sieve Size (mm)	Weight of Sieve (g)	Weight of Sieve + Soil (g)	Weight of Soil (g)	% Retained	Cumulative % Ret.	% Finer
44.45	0	0	0	0%	0%	100%
8	525.51	627.1	101.59	7%	7%	93%
2	479.61	659.86	180.25	13%	20%	80%
1	500.31	653.16	152.85	11%	30%	70%
0.5	441.02	847.43	406.41	28%	59%	41%
0.25	392.91	789.71	396.8	28%	86%	14%
0.125	377.3	521.39	144.09	10%	97%	3%
0.063	359.61	399.39	39.78	3%	99%	1%
Pan	371.72	381.58	9.86	1%	100%	0%
		Total Weight of Sample	**1431.63**			

Figure G.16.3.
Photo of sediment sample from the L-07-A site

Table G.16.3.
Sediment sieve analysis
Sample ID: L-07-A Lake Fork Gunnison River
Sample Description: 2 of 2
Performed by: JE
Date: 9-11-2012

Sieve Size (mm)	% Finer
44.45	100%
4	81%
2	79%
1	75%
0.5	74%
0.25	25%
0.125	6%
0.075	2%

Figure G.16.4.
Grain size gradation curve for the sediment sample collected from Lake Fork Gunnison River in the vicinity of L-07-A

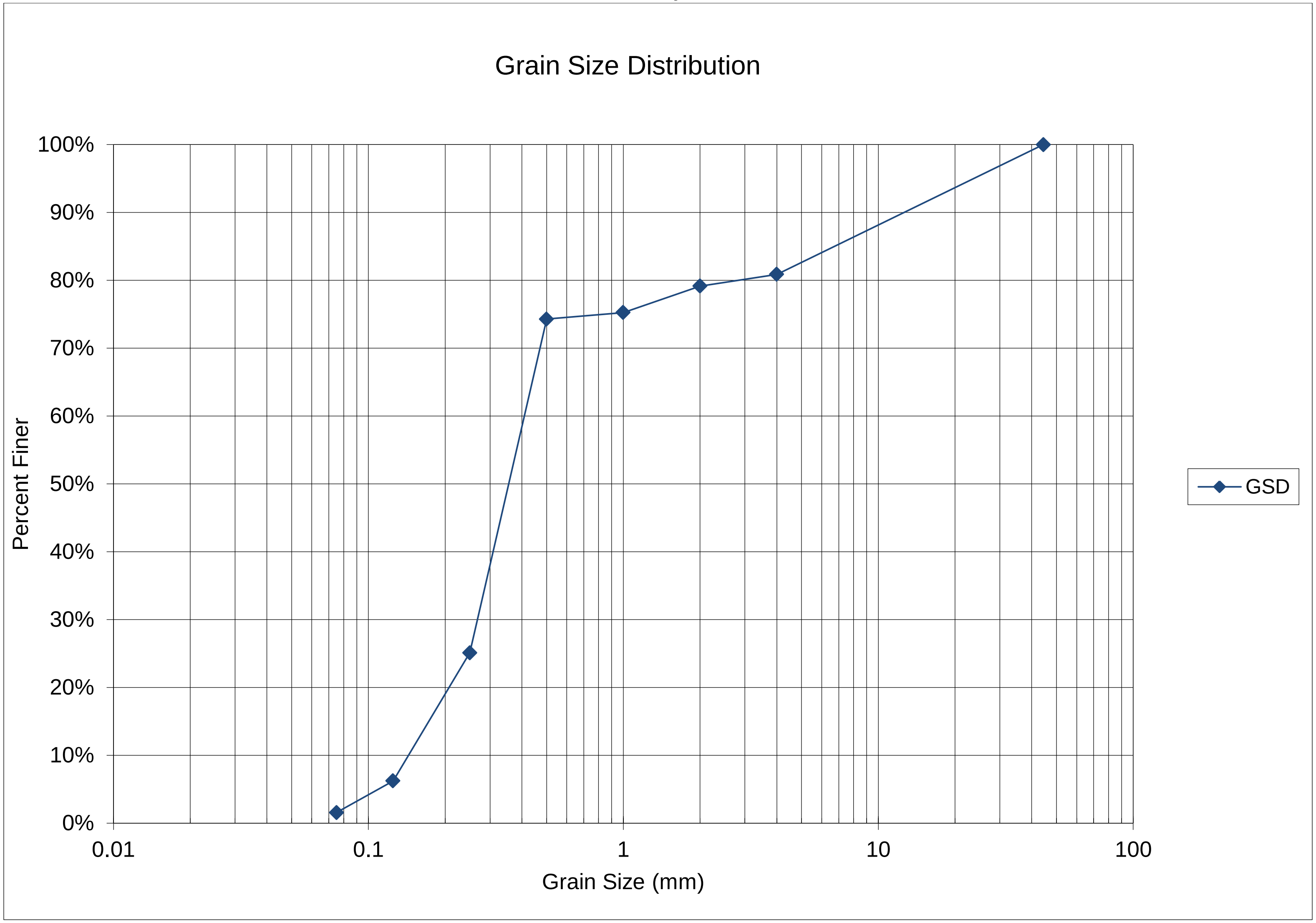


Table G.16.4.

Grain size gradation computations for the sediment sample collected from Lake Fork Gunnison River in the vicinity of L-07-A

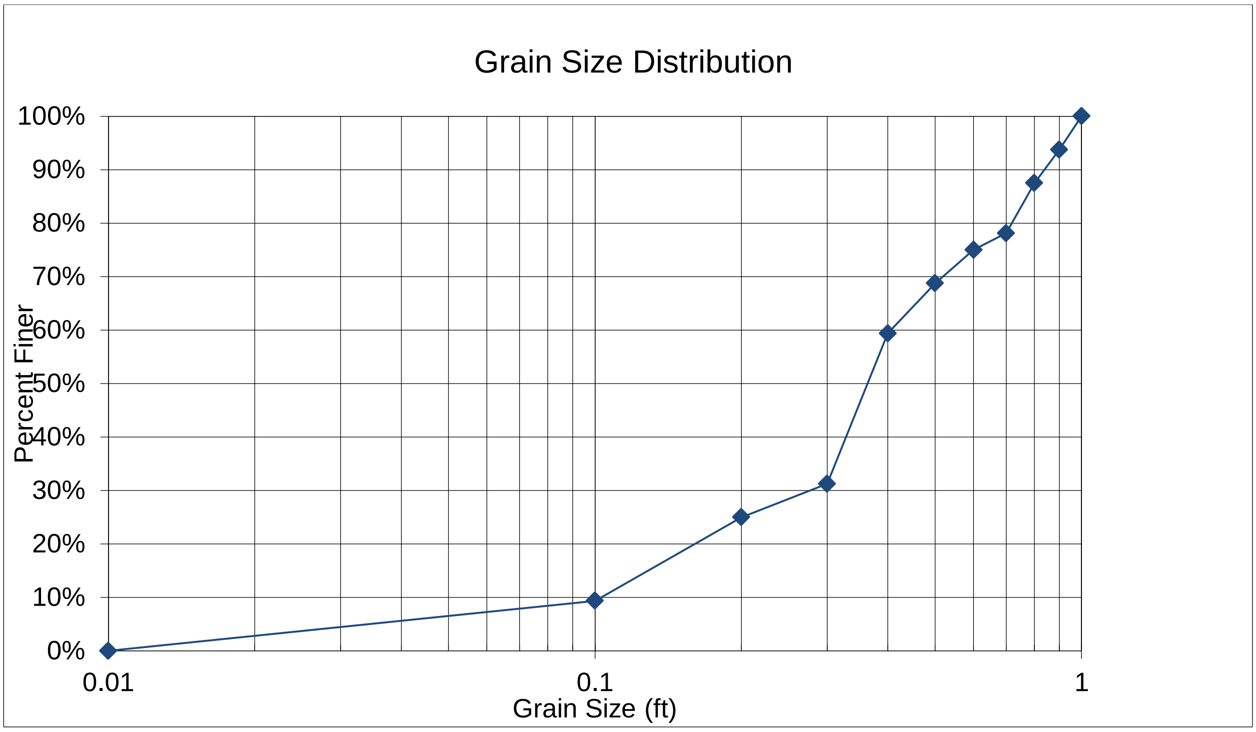
Structure # L-07-A	**Waterbody - Lake Fork Gunnison River**	**Sample # 2 of 2**	Performed by: JE			
			Date: 9/11/2012			
Sieve Size (mm)	Weight of Sieve (g)	Weight of Sieve + Soil (g)	Weight of Soil (g)	% Retained	Cumulative % Ret.	% Finer
44.45	0	0	0	0%	0%	100%
4	491.59	829.33	337.74	19%	19%	81%
2	479.61	510.21	30.6	2%	21%	79%
1	500.31	569.18	68.87	4%	25%	75%
0.5	441.02	458.18	17.16	1%	26%	74%
0.25	392.91	1262.2	869.29	49%	75%	25%
0.125	377.3	710.84	333.54	19%	94%	6%
0.075	321.91	404.41	82.5	5%	98%	2%
Pan	371.72	399.11	27.39	2%	100%	0%
		Total Weight of Sample	**1767.09**			

Pebble Count Grain Size Distribution

Region	Structure ID	County	Facility Carried	Mile Marker	POA Fiscal Year	Feature Intersected	D_{50} min from POA	D_{50} max from POA	Date
3	L-07-A	Gunnison	SH 149 ML	86.7	2013	Lake Fork Gunnison River	0.35	0.6	8/8/2013

Sample #	A (ft)	B (ft)	C (ft)	Shape Factor	D_s (ft)	D_{avg} (ft)	Volume (ft^3)
1	0.3	0.015	0.01	0.149	0.015	0.108	0.000
2	0.18	0.14	0.07	0.441	0.14	0.130	0.001
3	0.6	0.4	0.37	0.755	0.4	0.457	0.046
4	0.1	0.07	0.05	0.598	0.07	0.073	0.000
5	0.4	0.23	0.2	0.659	0.23	0.277	0.010
6	0.27	0.21	0.13	0.546	0.21	0.203	0.004
7	0.48	0.35	0.3	0.732	0.35	0.377	0.026
8	0.45	0.37	0.2	0.490	0.37	0.340	0.017
9	0.48	0.31	0.15	0.389	0.31	0.313	0.012
10	0.75	0.52	0.45	0.721	0.52	0.573	0.092
11	0.48	0.39	0.2	0.462	0.39	0.357	0.020
12	0.95	0.9	0.45	0.487	0.9	0.767	0.201
13	0.68	0.37	0.26	0.518	0.37	0.437	0.034
14	0.46	0.32	0.15	0.391	0.32	0.310	0.012
15	0.85	0.75	0.4	0.501	0.75	0.667	0.134
16	1.2	0.9	0.7	0.674	0.9	0.933	0.396
17	0.71	0.45	0.15	0.265	0.45	0.437	0.025
18	1.3	0.8	0.4	0.392	0.8	0.833	0.218
19	1	0.4	0.32	0.506	0.4	0.573	0.067
20	0.16	0.11	0.08	0.603	0.11	0.117	0.001
21	0.38	0.3	0.18	0.533	0.3	0.287	0.011
22	0.58	0.35	0.19	0.422	0.35	0.373	0.020
23	1.1	0.6	0.5	0.615	0.6	0.733	0.173
24	0.46	0.38	0.34	0.813	0.38	0.393	0.031
25	0.38	0.18	0.1	0.382	0.18	0.220	0.004
26	0.9	0.75	0.4	0.487	0.75	0.683	0.141
27	0.66	0.55	0.15	0.249	0.55	0.453	0.029
28	0.14	0.1	0.08	0.676	0.1	0.107	0.001
29	0.24	0.15	0.08	0.422	0.15	0.157	0.002
30	0.8	0.8	0.35	0.438	0.8	0.650	0.117
31	0.45	0.4	0.35	0.825	0.4	0.400	0.033
32	1	0.7	0.7	0.837	0.7	0.800	0.257

Structure # L-07-A	Lake Fork Gunnison River at SH 149			
Sieve Size (ft)	Samples Retained	% Retained	Cumulative % Ret.	% Finer
1	0	0%	0%	100%
0.9	2	6%	6%	94%
0.8	2	6%	13%	88%
0.7	3	9%	22%	78%
0.6	1	3%	25%	75%
0.5	2	6%	31%	69%
0.4	3	9%	41%	59%
0.3	9	28%	69%	31%
0.2	2	6%	75%	25%
0.1	5	16%	91%	9%
0.01	3	9%	100%	0%
Total Samples	32			



Hydraulic Analysis Report

Project Data

Project Title: L-07-A

Designer:

Project Date: Thursday, September 26, 2013

Project Units: U.S. Customary Units

Notes:

Wolman Count Analysis: Rock/Sediment Gradation Analysis

Notes:

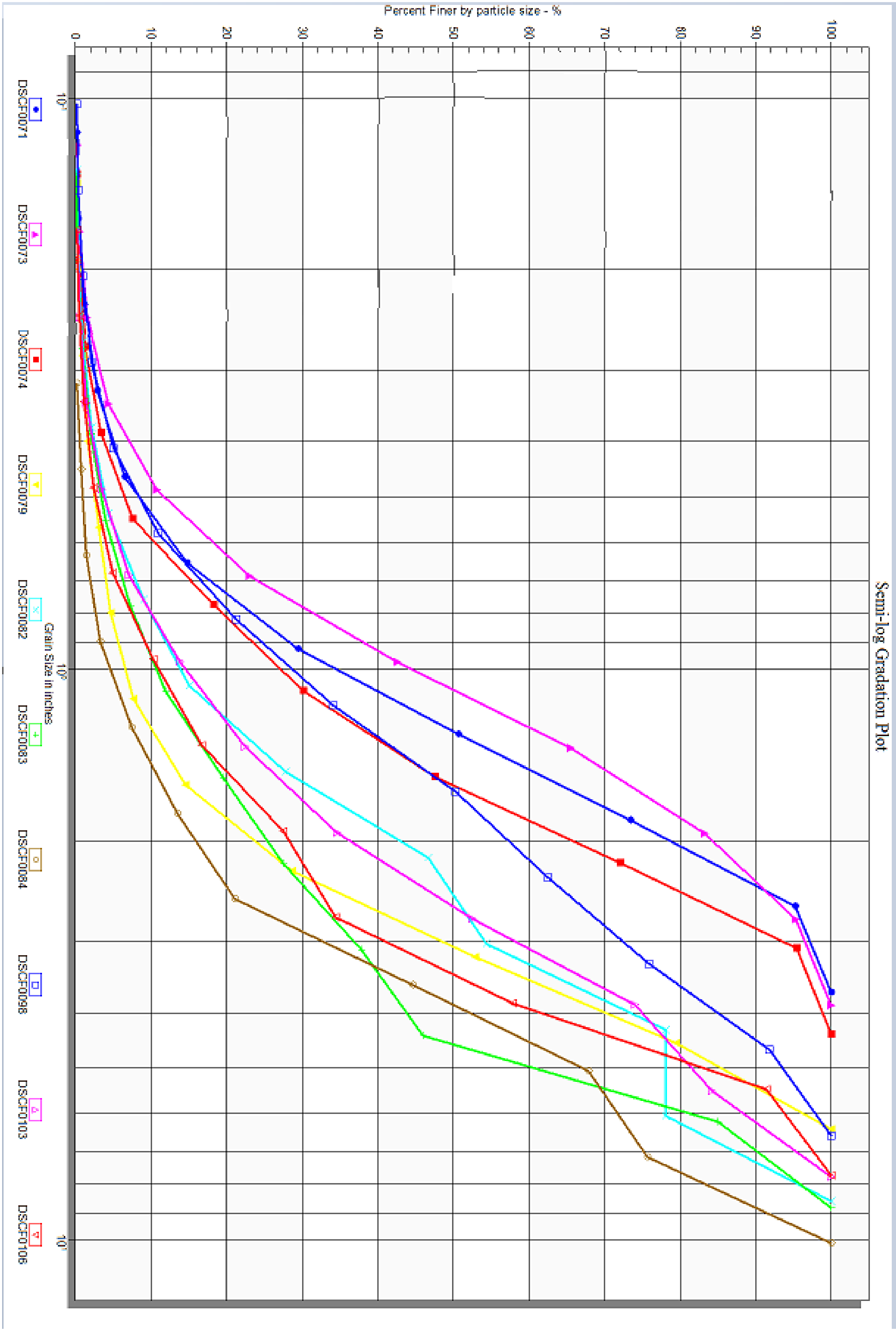

Semi-log Gradation Plot
Percent Finer by particle size - %
Grain Size in inches
DSCF0071
DSCF0073
DSCF0074
DSCF0079
DSCF0082
DSCF0083
DSCF0084
DSCF0098
DSCF0103
DSCF0106

Image Gradation Input Parameters

Name: DSCF0071

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0071.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 183

Morphologic Iterations: 1

Resolution: 31 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.028797	0	0	0.000000
0.040725	0	0	0.000000
0.057594	0	0	0.000000
0.081450	0	0	0.000000
0.115187	2	2	0.125156
0.162899	4	6	0.375469
0.230374	12	18	1.126408
0.325799	28	46	2.878598
0.460749	58	104	6.508135
0.651597	131	235	14.705882
0.921498	236	471	29.474343
1.303195	338	809	50.625782
1.842995	365	1174	73.466834
2.606389	347	1521	95.181477
3.685991	77	1598	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.4047 in

D15: 0.6570 in

D50: 1.2919 in

D85: 2.2485 in

D100: 3.6860 in

Image Gradation Input Parameters

Name: DSCF0073

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0073.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 182

Morphologic Iterations: 1

Resolution: 30 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.021481	0	0	0.000000
0.030379	0	0	0.000000
0.042963	0	0	0.000000
0.060758	0	0	0.000000
0.085925	0	0	0.000000
0.121517	2	2	0.164609
0.171851	5	7	0.576132
0.243034	11	18	1.481481
0.343702	35	53	4.362140
0.486068	78	131	10.781893
0.687404	149	280	23.045267
0.972136	237	517	42.551440
1.374807	279	796	65.514403
1.944271	215	1011	83.209877
2.749615	147	1158	95.308642
3.888543	57	1215	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.3578 in

D15: 0.5553 in

D50: 1.1028 in

D85: 2.0634 in

D100: 3.8885 in

Image Gradation Input Parameters

Name: DSCF0074

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0074.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 172

Morphologic Iterations: 1

Resolution: 29 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.024126	0	0	0.000000
0.034119	0	0	0.000000
0.048252	0	0	0.000000
0.068238	0	0	0.000000
0.096504	0	0	0.000000
0.136477	1	1	0.103413
0.193007	3	4	0.413650
0.272953	8	12	1.240951
0.386014	20	32	3.309204
0.545907	41	73	7.549121
0.772028	103	176	18.200620
1.091813	115	291	30.093071
1.544057	169	460	47.569804
2.183626	237	697	72.078594
3.088114	226	923	95.449845
4.367252	44	967	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.4498 in

D15: 0.7041 in

D50: 1.6075 in

D85: 2.6837 in

D100: 4.3673 in

Image Gradation Input Parameters

Name: DSCF0079

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0079.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 186

Morphologic Iterations: 1

Resolution: 31 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.035315	0	0	0.000000
0.049942	0	0	0.000000
0.070629	0	0	0.000000
0.099885	0	0	0.000000
0.141258	1	1	0.101010
0.199770	3	4	0.404040
0.282517	5	9	0.909091
0.399539	7	16	1.616162
0.565034	14	30	3.030303
0.799078	16	46	4.646465
1.130067	30	76	7.676768
1.598156	68	144	14.545455
2.260134	140	284	28.686869
3.196313	240	524	52.929293
4.520269	263	787	79.494949
6.392625	203	990	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.8377 in

D15: 1.6194 in

D50: 3.0832 in

D85: 5.0229 in

D100: 6.3926 in

Image Gradation Input Parameters

Name: DSCF0082

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0082.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 185

Morphologic Iterations: 1

Resolution: 32 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.033450	0	0	0.000000
0.047305	0	0	0.000000
0.066899	0	0	0.000000
0.094610	0	0	0.000000
0.133799	1	1	0.111982
0.189220	2	3	0.335946
0.267598	5	8	0.895857
0.378441	11	19	2.127660
0.535196	20	39	4.367301
0.756881	41	80	8.958567
1.070392	54	134	15.005599
1.513762	114	248	27.771557
2.140783	169	417	46.696529
3.027524	68	485	54.311310
4.281566	212	697	78.051512
6.055049	0	697	78.051512
8.563132	196	893	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.5657 in

D15: 1.0701 in

D50: 2.5255 in

D85: 6.8491 in

D100: 8.5631 in

Image Gradation Input Parameters

Name: DSCF0083

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0083.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 188

Morphologic Iterations: 1

Resolution: 33 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.034291	0	0	0.000000
0.048495	0	0	0.000000
0.068583	0	0	0.000000
0.096991	0	0	0.000000
0.137166	1	1	0.096246
0.193982	2	3	0.288739
0.274332	6	9	0.866218
0.387963	12	21	2.021174
0.548663	20	41	3.946102
0.775927	34	75	7.218479
1.097326	49	124	11.934552
1.551854	79	203	19.538017
2.194652	83	286	27.526468
3.103707	107	393	37.824832
4.389305	85	478	46.005775
6.207415	405	883	84.985563
8.778610	156	1039	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.6219 in

D15: 1.2806 in

D50: 4.5756 in

D85: 6.2099 in

D100: 8.7786 in

Image Gradation Input Parameters

Name: DSCF0084

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0098.JPG

- Scale Line Length: 24 in
- Median Filter Radius: 2 px
- Background Subtraction Radius: 3 px
- Advanced Controls:
  - Automate Threshold Selection
  - Threshold Value: 176
  - Morphologic Iterations: 1
  - Resolution: 31 %
  - Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.039564	0	0	0.000000
0.055951	0	0	0.000000
0.079127	0	0	0.000000
0.111903	0	0	0.000000
0.158254	0	0	0.000000
0.223805	0	0	0.000000
0.316508	1	1	0.181488
0.447610	3	4	0.725953
0.633017	4	8	1.451906
0.895221	10	18	3.266788
1.266033	23	41	7.441016
1.790441	33	74	13.430127
2.532066	42	116	21.052632
3.580882	130	246	44.646098
5.064133	128	374	67.876588
7.161765	43	417	75.680581
10.128265	134	551	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 1.0492 in

D15: 1.9432 in

D50: 3.9227 in

D85: 8.2986 in

D100: 10.1283 in

Image Gradation Input Parameters

Name: DSCF0098

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0098.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 194

Morphologic Iterations: 1

Resolution: 38 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.025632	0	0	0.000000
0.036249	0	0	0.000000
0.051263	0	0	0.000000
0.072497	0	0	0.000000
0.102527	2	2	0.101420
0.144995	4	6	0.304260
0.205053	12	18	0.912779
0.289989	24	42	2.129817
0.410106	56	98	4.969574
0.579978	118	216	10.953347
0.820213	204	420	21.298174
1.159956	252	672	34.077079
1.640426	319	991	50.253550
2.319913	241	1232	62.474645
3.280852	264	1496	75.862069
4.639825	314	1810	91.784990
6.561704	162	1972	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.4110 in

D15: 0.6740 in

D50: 1.6329 in

D85: 4.0607 in

D100: 6.5617 in

Image Gradation Input Parameters

Name: DSCF0103

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0103.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 178

Morphologic Iterations: 1

Resolution: 32 %

Flood Depth: 0.9 px

Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.030284	0	0	0.000000
0.042828	0	0	0.000000
0.060568	0	0	0.000000
0.085656	0	0	0.000000
0.121136	0	0	0.000000
0.171313	2	2	0.253165
0.242273	2	4	0.506329
0.342625	7	11	1.392405
0.484545	16	27	3.417722
0.685250	29	56	7.088608
0.969090	53	109	13.797468
1.370500	68	177	22.405063
1.938180	96	273	34.556962
2.741001	142	415	52.531646
3.876360	170	585	74.050633
5.482001	80	665	84.177215
7.752721	125	790	100.000000

Gradation Result Parameters

Gradation Result Parameters

D5: 0.5711 in

D15: 1.0252 in

D50: 2.6279 in

D85: 5.6001 in

D100: 7.7527 in

Image Gradation Input Parameters

Name: DSCF0106

Gradation Type: Image Gradation

Number of Images: 1

Image Path: Hydraulic Toolbox GSD_Images\DSCF0106.JPG

Scale Line Length: 24 in

Median Filter Radius: 2 px

Background Subtraction Radius: 3 px

Advanced Controls:

Automate Threshold Selection

Threshold Value: 177

Morphologic Iterations: 1

Resolution: 31 %

Flood Depth: 0.9 px

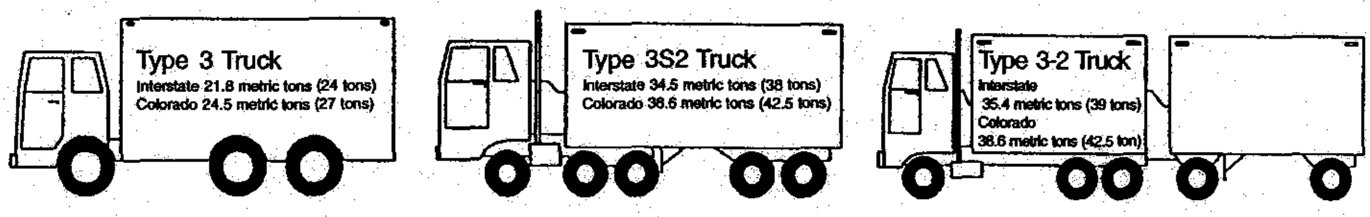
Gradation Results

Particle Size in	Particle count	Cumulative Particle count	Cumulative Percent Finer (%)
0.030082	0	0	0.000000
0.042543	0	0	0.000000
0.060164	0	0	0.000000
0.085085	0	0	0.000000
0.120329	0	0	0.000000
0.170171	2	2	0.193798
0.240658	3	5	0.484496
0.340341	7	12	1.162791
0.481315	13	25	2.422481
0.680683	26	51	4.941860
0.962631	55	106	10.271318
1.361365	66	172	16.666667
1.925261	112	284	27.519380
2.722731	71	355	34.399225
3.850523	242	597	57.848837
5.445462	346	943	91.375969
7.701046	89	1032	100.000000

APPENDIX E – EXISTING BRIDGE PLANS & SUBSURFACE INFORMATION

COLORADO DEPARTMENT OF TRANSPORTATION **LOAD FACTOR RATING SUMMARY**	
	Structure # C-09-AR
	State highway # 131
Rated using Asphalt thickness: 100 mm (4 in.) ☒ Colorado legal loads ☐ Interstate legal loads	Batch I.D. VIRTIS BID #1301
	Structure type CICK
	Parallel structure #

Structural member	INTERIOR GIRDER G01	DECK SLAB		
	Metric tons (Tons)			
Inventory	28 (31)	31 (35)	( )	( )
Operating	47 (52)	53 (59)	( )	( )
Type 3 truck	( )	( )	( )	( )
Type 3S2 truck	( )	( )	( )	( )
Type 3-2 truck	( )	( )	( )	( )
Permit truck	104 (115)	( )	( )	( )



Type 3 Truck	Type 3S2 Truck	Type 3-2 Truck
______ Metric tons (______) Tons	______ Metric tons (______) Tons	______ Metric tons (______) Tons

Comments

Color Code: WHITE

Rated by	Date	Checked by	Date
MAC HASAN, PE, SE	6/8/04	Ali Harajli, PEI	9/14/04

Previous editions are obsolete and may not be used

CDOT Form #1187a 1/95

FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	RS 0131 (7)	6	

REVISIONS

AS CONSTRUCTED — NO REVISIONS ☐ REVISED 6-7-77 VOID ☐

GENERAL NOTES:

1) All work ~~shall be~~ WAS done according to the Standard Specifications of the Division of Highways, State of Colorado, applicable to the Project.

2) All concrete surfaces marked with the symbol *f* as shown on Dwg. No. B-11 ~~shall~~ DID receive a Class 2 surface finish.

3) Soundings and depth of footings ~~are~~ WERE in accordance with the best available data. When different conditions ~~are~~ WERE encountered, the Bridge Engineer will inspect and determine if redesign is necessary.

4) When excavating for footings, the final six inches in depth ~~shall be~~ WAS done by hand labor methods.

5) Footings in rock ~~shall~~ WAS not ~~be~~ formed but ~~shall be~~ placed against undisturbed rock.

6) For details of structure excavation and structure backfill, See Standard M-206-AB.

7) Table shows minimum lap for common bar sizes:

Bar Size No.	4	5	6	7	8	9	10	11
Splice Length	1'-0"	1'-2"	1'-8"	2'-3"	3'-0"	3'-10"	4'-10"	6'-0"

8) Location of all construction joints ~~shall be~~ WAS approved by the Engineer.

9) All concrete chamfers ~~shall be~~ WERE ¾ inch unless otherwise noted.

10) Expansion joint material ~~shall~~ DID meet the A.A.S.H.T.O. Specification M213-65 and ~~shall be~~ WAS included in the payment for Item 601.

11) All structural steel not otherwise noted ~~shall be~~ WAS A.A.S.H.T.O. Specification M-183 (A.S.T.M. A36).

12) All structural steel not otherwise noted WAS ~~shall be~~ painted in accordance with Section 509 for Spruce Green Paint.

13) All bolts ~~shall be~~ WERE ¾" diameter, high strength, unless otherwise noted.

14) No welding of any kind ~~shall be~~ WAS permitted on the flanges of steel girders unless specifically called for on the plans.

15) Grade 60 reinforcing steel required for #5 bars and larger. Grade 40 or Grade 60 ~~may be~~ WERE furnished for #4 bars.

16) Abbreviations:
E.F. = Each Face
N.F. = Near Face
F.F. = Far Face

Cross Reference: Drawing Number / Section or Detail Identification

17) Concrete deck ~~shall~~ DID receive a transverse fiber broom finish.

LOADING DATA:

Liveload: A.A.S.H.T.O. HS-20-44

Deadload: Assumes 25 lbs. per sq. ft. for bituminous pavement.

DESIGN DATA: YR. OF CONSTR. = 1976

A.A.S.H.T.O 1973 Unit Stresses, except as noted:

Reinforcing Steel: #5 bars & larger — f_s = 24,000 psi Fy=60 except; f_s = 20,000 psi in transverse deck slab. Fy=40 or =60 ksi; #4 bars — f_s = 20,000 psi

Structural Steel: A36 — F_s = 20,000 lbs. per sq. in.; A572 Grade 50 — F_s = 27,000 lbs. per sq. in.

Concrete: F_c = 1,200 lbs. per sq. in.; n = 10; F'_c = 3000 PSI

INDEX OF DRAWINGS

BOOK 1

SUMMARY OF QUANTITIES

Item No.	Description	Unit	Super-structure	Abut. No. 1	Pier No. 2	Pier No. 3	Abut. No. 4	Total	
202	Removal of Bridge	Each						1	
206	Structure Excavation	Cu.Yd.		25	70	70	25	190	
206	Structure Backfill (Class 2)	Cu.Yd.		20	45	45	20	130	
403	Hot Bituminous Pavement (Gr E) (H - A)	Ton	58					58	
(1) 502	Steel Piling (HP 12 × 53)	Lin. Ft.		~~80~~ 81.1	~~70~~ 59.4	~~70~~ 59.8	~~80~~ 83.0	~~300~~ 287	Page 25
502	Reinforcing Tie	Each		4	6	6	4	20	
(2) 506	Riprap	Cu. Yd.		270			270	~~540~~ 516	Page 29
(3) 509	Structural Steel	Lb.	48,600		1,130	1,130		50,860	
509	Structural Steel (Galvanized)	Lb.	14,050					14,050	
601	Concrete Class A (Bridge)	Cu. Yd.		12.1	47.7	47.7	12.1	119.6	
601	Concrete Class D (Bridge)	Cu. Yd.	165.2					165.2	
602	Reinforcing Steel	Lb.	41,450	2,500	1,770	1,770	2,500	49,990	
606	Guard Rail Type 3A	Lin. Ft.	275					275	

(1) HPS 10 × 57 may be used in lieu of HP 12 × 53.
(2) 9" stone size.
(3) Includes 8 sq. ft. Elastomeric Bearing Pad Material.

BRIDGE DESCRIPTION

3 Simple Spans (32'-0", 45'-0", 32'-0")
Concrete Slab and I-beam Bridge
Over Yampa River
44'-0" Roadway curb to curb, 90° skew,
1'-3" Curbs with Bridge Rail Type 3.

Sta 223+94.25 to 225+05.75
South of Steamboat Springs
Sect. 16, T. 5 N., R. 84 W.

DIVISION OF HIGHWAYS

IHLENFELDT, PETERSON & HANEY, INC.
STRUCTURAL ENGINEERS

GENERAL INFORMATION
SUMMARY OF QUANTITIES

Designer B. Riddell √LDP — Structure Numbers: C-9-AR
Detailer B. Walton
Drawing Number B 1 of 15 Drawings

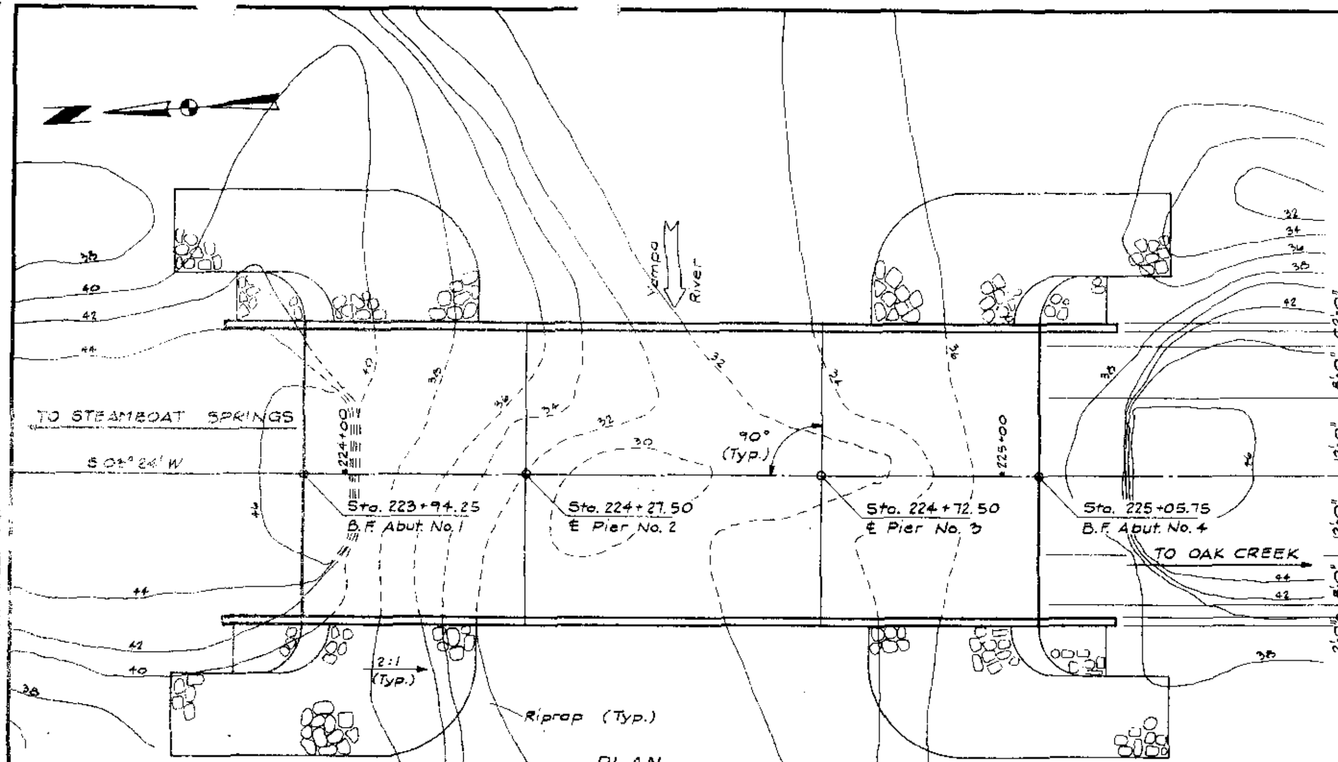
Revision Dates (Preliminary Stage Only)

FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	RS 0131(7)	7	

REVISIONS

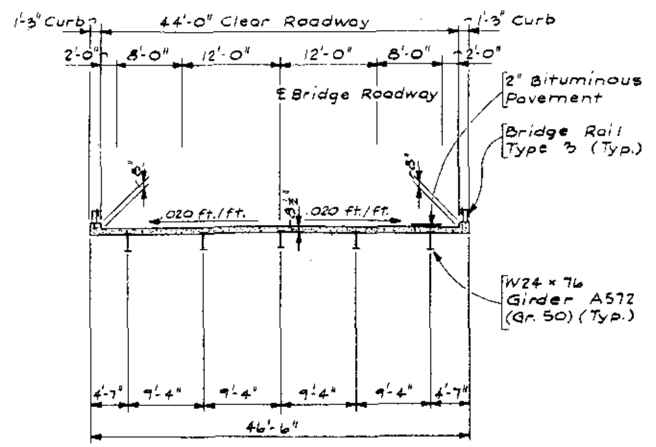
AS CONSTRUCTED

NO REVISIONS 6-1-77 REVISED VOID

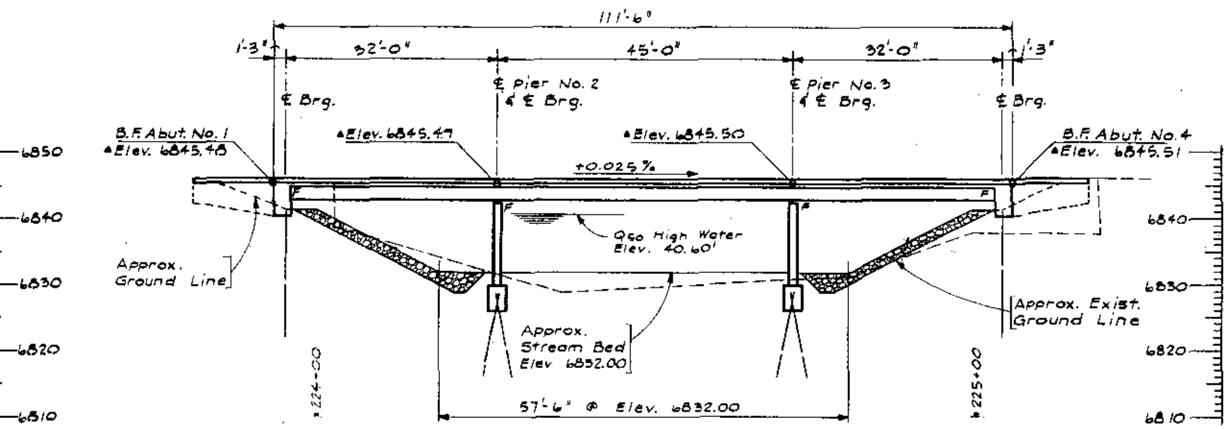


PLAN

For channel width and riprap details, see Dwg. No. B-4.

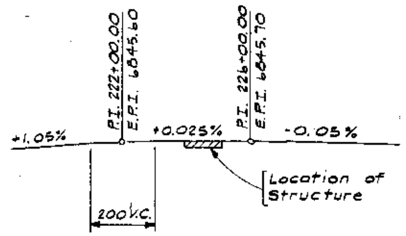


TYPICAL SECTION



SECTION AT PROFILE GRADE

Elevations shown thus (▲Elev. 6845.48) are top of concrete, 2" below finish grade.



PROFILE GRADE DATA

NOTES:

1)

Pile Size	Location	Est. Tip Elev.
HP 12 × 53	Abut No. 1	6822
HP 12 × 53	Pier No. 2	6816
HP 12 × 53	Pier No. 3	6816
HP 12 × 53	Abut No. 4	6822

All piles are end bearing.

2) Live Loading HS-20-44.

3) Q_{50} = 4500 c.f.s., Drainage Area = 399 sq. mi. Based on U.S.G.S. stream gage analysis and U.S.G.S. Regional analysis.

DIVISION OF HIGHWAYS

IHLENFELDT, PETERSON & HANEY, INC.
STRUCTURAL ENGINEERS

GENERAL LAYOUT

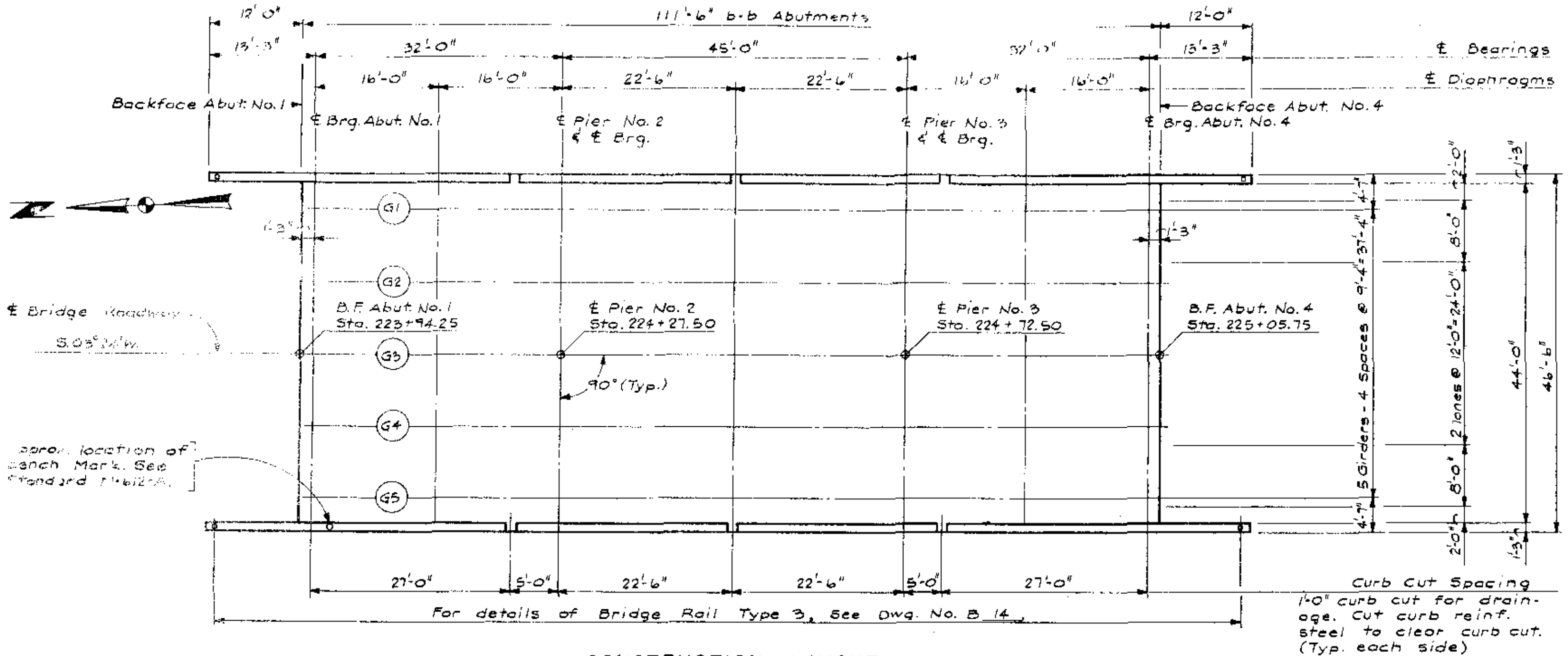
Designer B. Riddell / IDP	Structure Numbers	C-9-AR	
Detailer B. Walton			
Drawing Number B 2	of	15	Drawings

FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	RS 0131(7)	11	

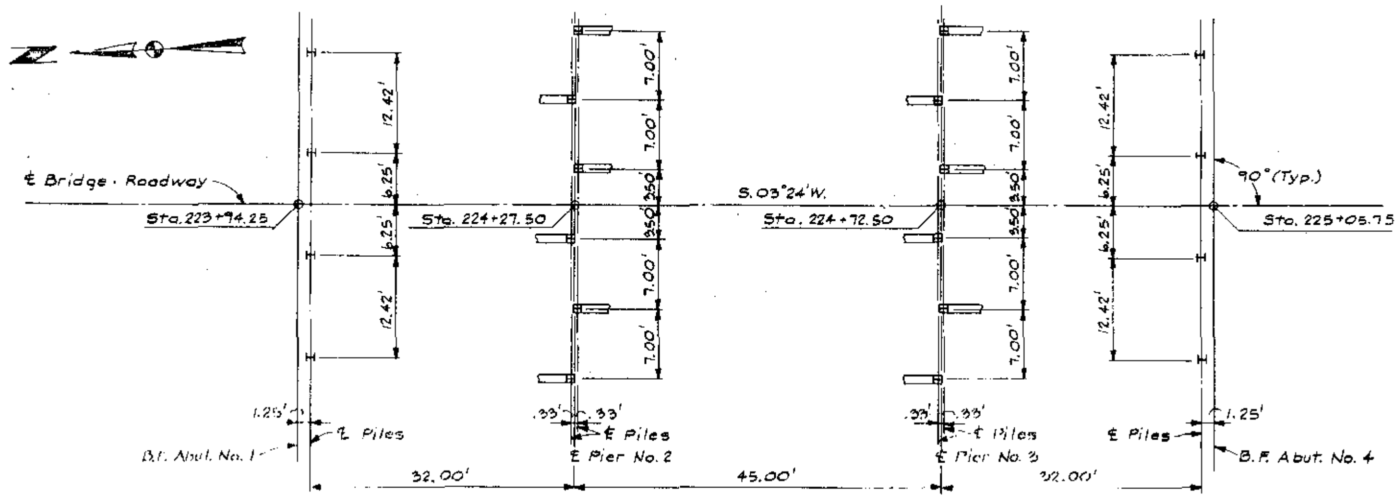
REVISIONS

AS CONSTRUCTED

NO REVISIONS [ ] REVISED 6-1-77 VOID [ ]



CONSTRUCTION LAYOUT



PILING LAYOUT

NOTES:

1. Piles shown thus ( ) ~~shall be~~ WERE battered 2:12.
2. All piling dimensions are at bottom of concrete.
3. Abutment piling ~~shall be~~ WAS end bearing HP 12 × 53, Maximum Pile Load = 53.5 T.
   Pier piling ~~shall be~~ WAS end bearing HP 12 × 53, Maximum Pile Load = 70.0 T.
4. Curb cut locations ~~may be~~ WAS adjusted by the Engineer to miss Rail Post locations.

DIVISION OF HIGHWAYS

IHLENFELDT, PETERSON & HANEY, INC.
STRUCTURAL ENGINEERS

PILING AND CONSTRUCTION LAYOUTS

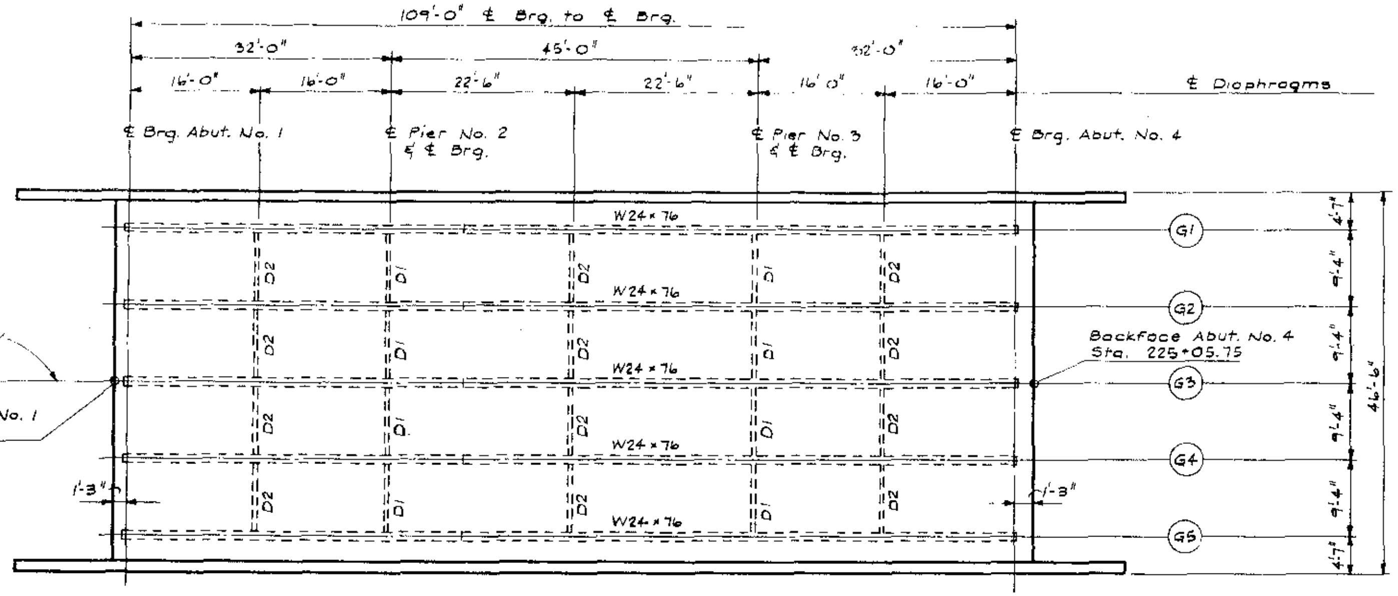
Designer	Tiddell / LDP	Structure Numbers	C-9-AR
Detailer	Walton		
Drawing Number B	6	of 15	Drawings

Revision Dates (Preliminary Stage Only)

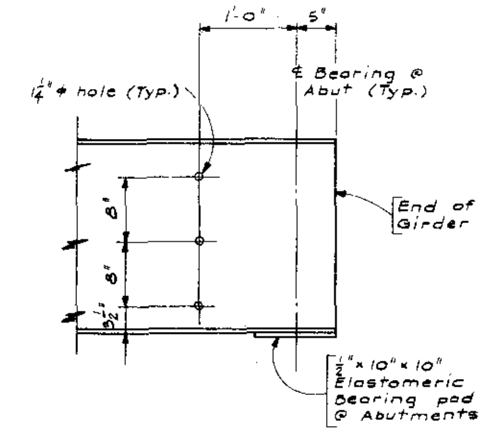
FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	RS 0131(7)	15	

REVISIONS

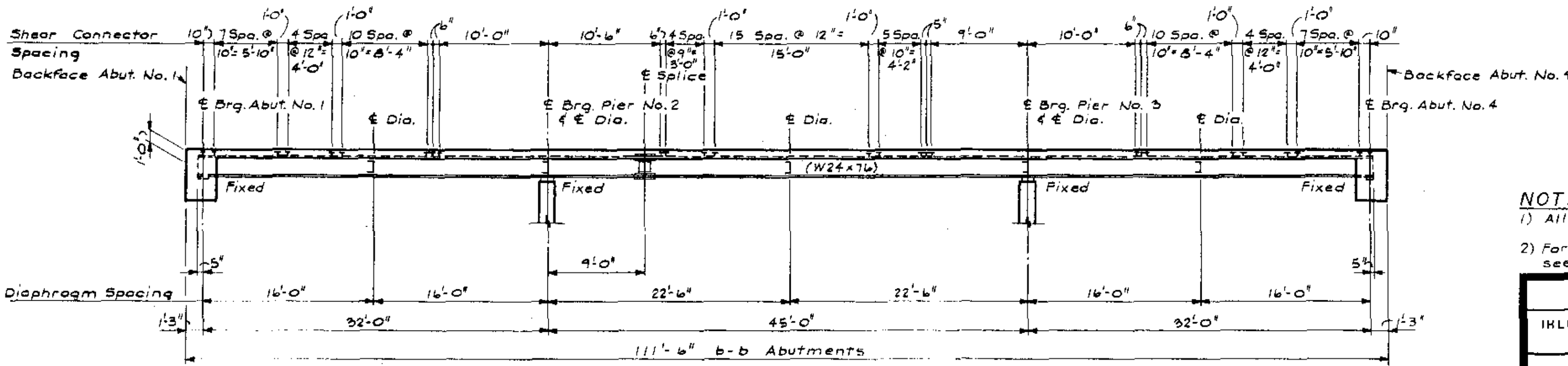
AS CONSTRUCTED
NO REVISIONS 6-1-77 REVISED VOID



PLAN



TYPICAL DETAIL AT END OF GIRDER



LONGITUDINAL SECTION

Note: Dead load deflection includes weight of slab & wearing surface

DEAD LOAD DEFLECTION	Tenth Point	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5
	Deflection in In.	0	.057	.104	.133	.141	.129	.098	.058	.017	-.009	0	.094	.233	.367	.461	.495

NOTES:
1) All W24×76 are A572 (Gr. 50) steel.
2) For Shear Connector details, see Dwg. No. B-12.

DIVISION OF HIGHWAYS

IHLENFELDT, PETERSON & HANEY, INC.
STRUCTURAL ENGINEERS

SUPERSTRUCTURE DETAILS

Designer [illegible] Structure Numbers C-9-AP
Detailer [illegible]
Drawing Number B 10 of 15 Drawings

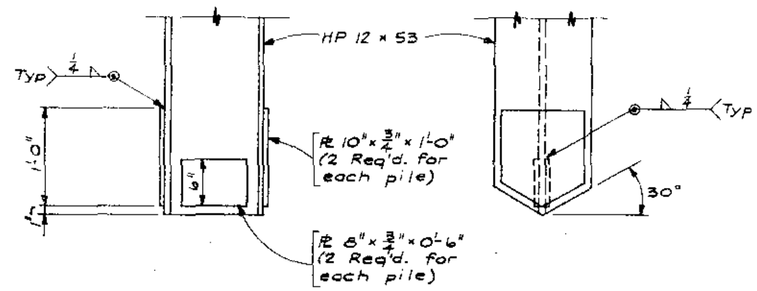
Revision Dates (Preliminary Stage Only)

STATE DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS - STATE OF COLORADO

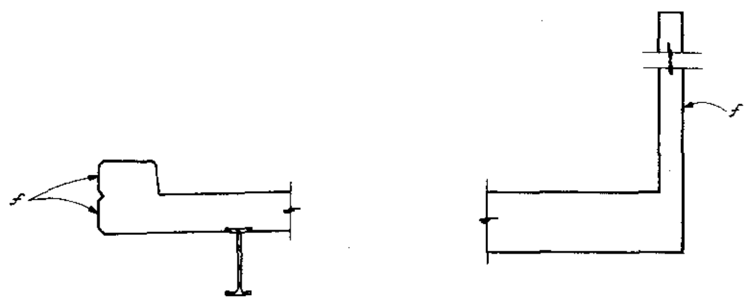
FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	RS 0131(7)	16	

REVISIONS

AS CONSTRUCTED
NO REVISIONS 6-1-77 REVISED VOID

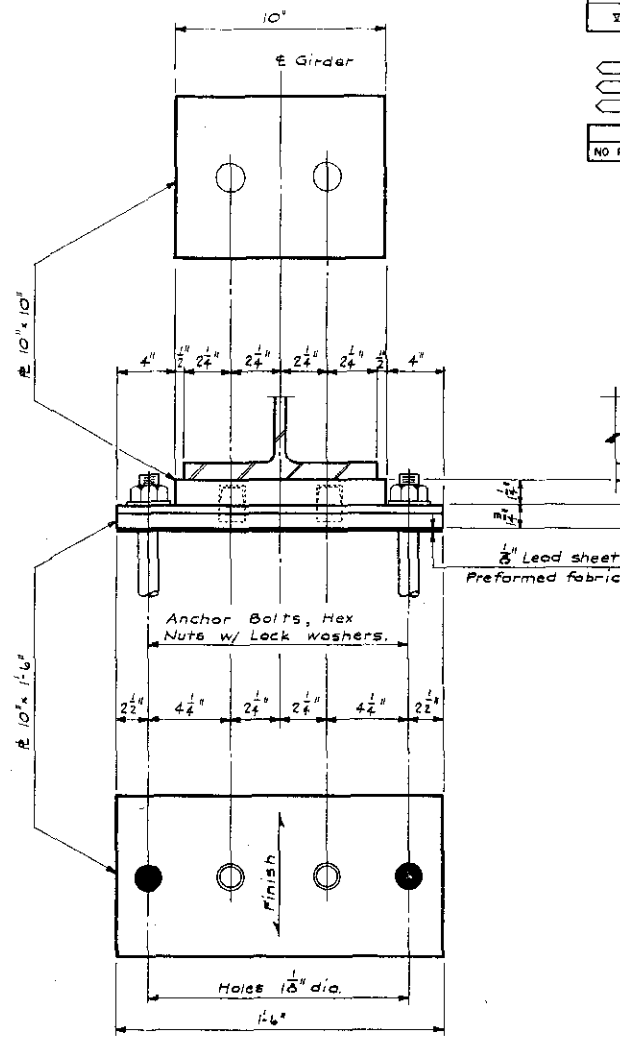


REINFORCING TIP DETAILS



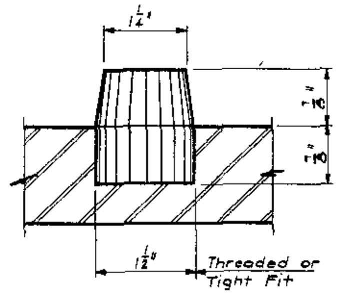
SURFACE FINISH DETAILS

Shows portions of structure to receive Class 2 Surface Finish.



FIXED BEARING DETAILS

5 Required @ Pier No. 2
5 Required @ Pier No. 3



PINTLE DETAIL

DIVISION OF HIGHWAYS

IHLENFELDT, PETERSON & HANEY, INC.
STRUCTURAL ENGINEERS

MISCELLANEOUS DETAILS

Designer B. Riddell VLDP
Detailer B. Walton
Structure Numbers C-9-AR
Drawing Number B 11 of 15 Drawings

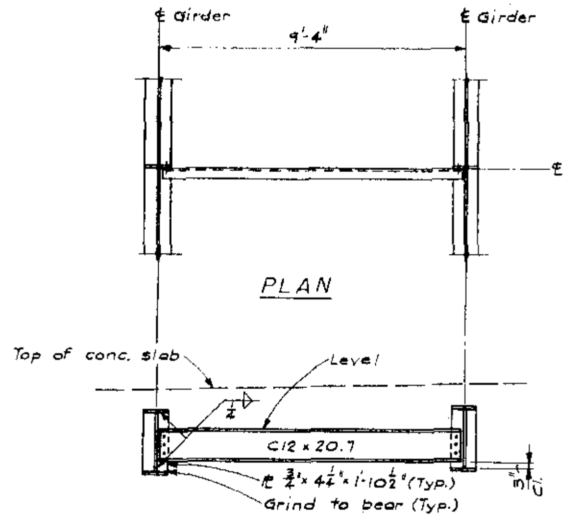
Revision Dates (Preliminary Stage Only)

DESIGNED BY / CHECKED BY / DETAILED BY / INITIAL / DATE / QUANTITIES BY / CHECKED BY

FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	RS 0131(7)	17	

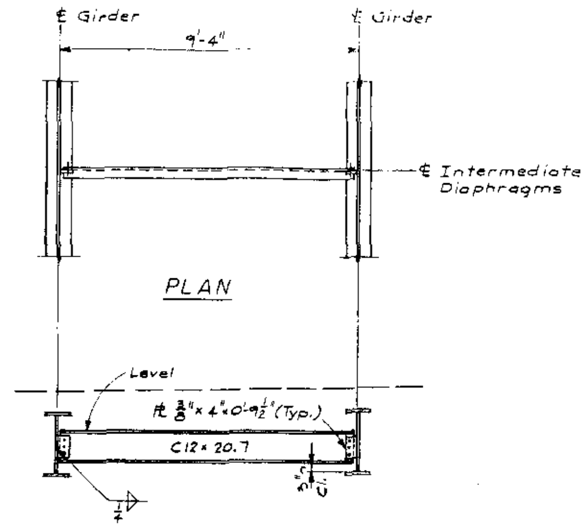
REVISIONS

AS CONSTRUCTED
NO REVISIONS 6-7-77 REVISED VOID



ELEVATION

DIAPHRAGM D1



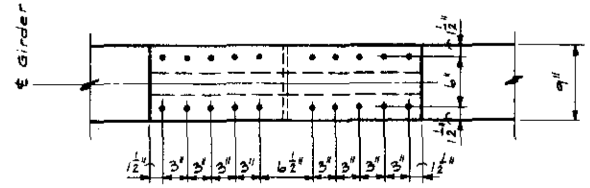
ELEVATION

DIAPHRAGM D2

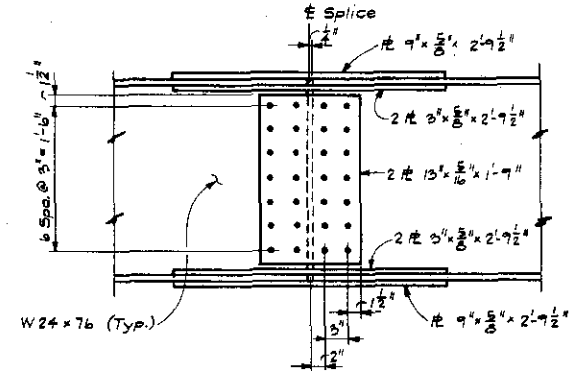
DIAPHRAGM DETAILS

NOTES:

1. All diaphragm bolts are 3/4" ϕ H.S.
2. Holes in diaphragm ℞'s shall be slotted (1 1/4" × 13/16" slots).
3. The intermediate diaphragm bolted connections shall not be torqued until the slab has been poured.



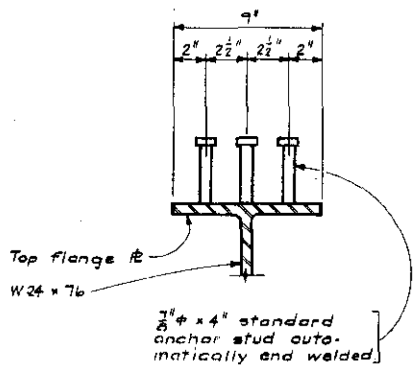
TOP AND BOTTOM PLATES



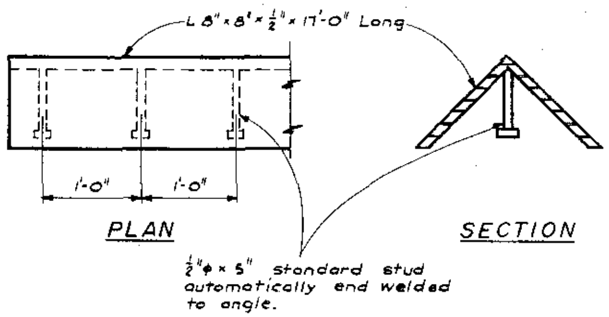
ELEVATION

SPLICE DETAILS

Note: All splice bolts are H.S. 7/8" ϕ.



SHEAR CONNECTOR DETAILS



PIER NOSE ANGLE DETAILS
(2 required)

DIVISION OF HIGHWAYS

IHLENFELDT, PETERSON & HANEY, INC.
STRUCTURAL ENGINEERS

MISCELLANEOUS DETAILS

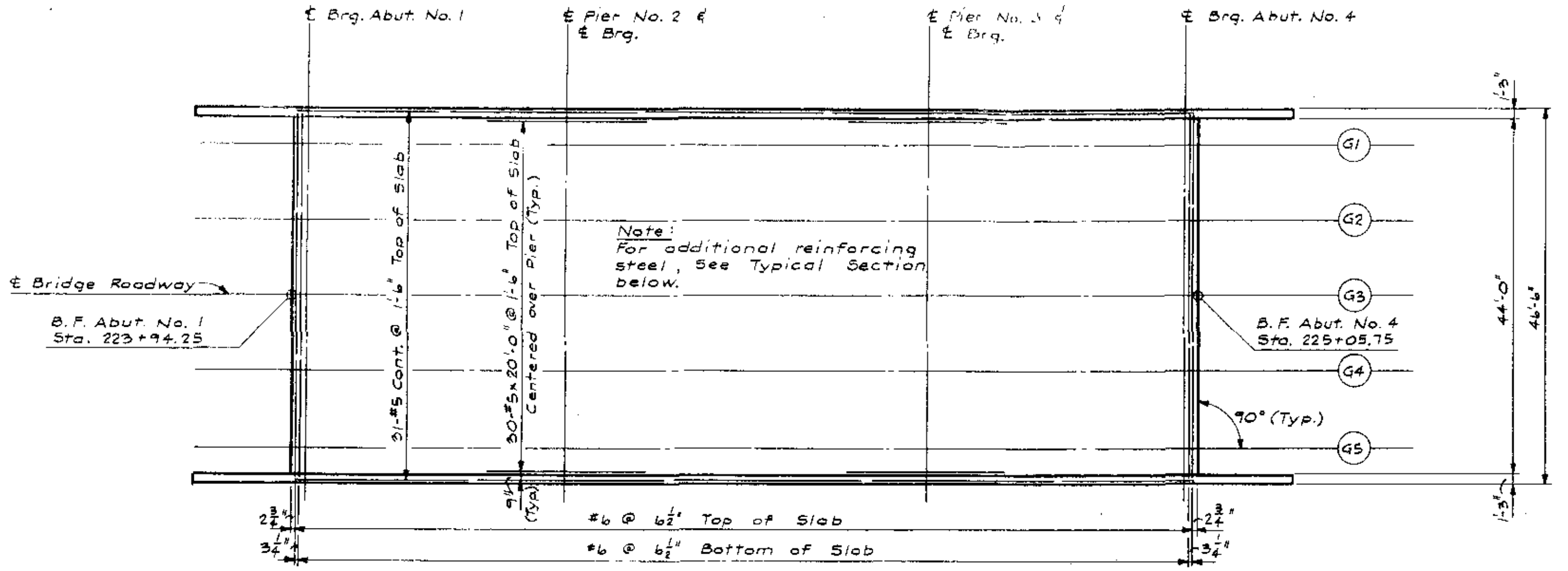
Designer R. Riddell / LDP — Structure Numbers C-9-AR
Detailer D. Walton
Drawing Number B 12 of 15 Drawings

Revision Dates (Preliminary Stage Only)

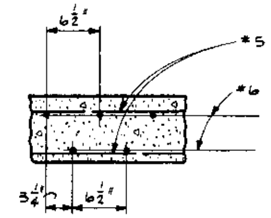
FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	RS 0131(7)	18	

REVISIONS

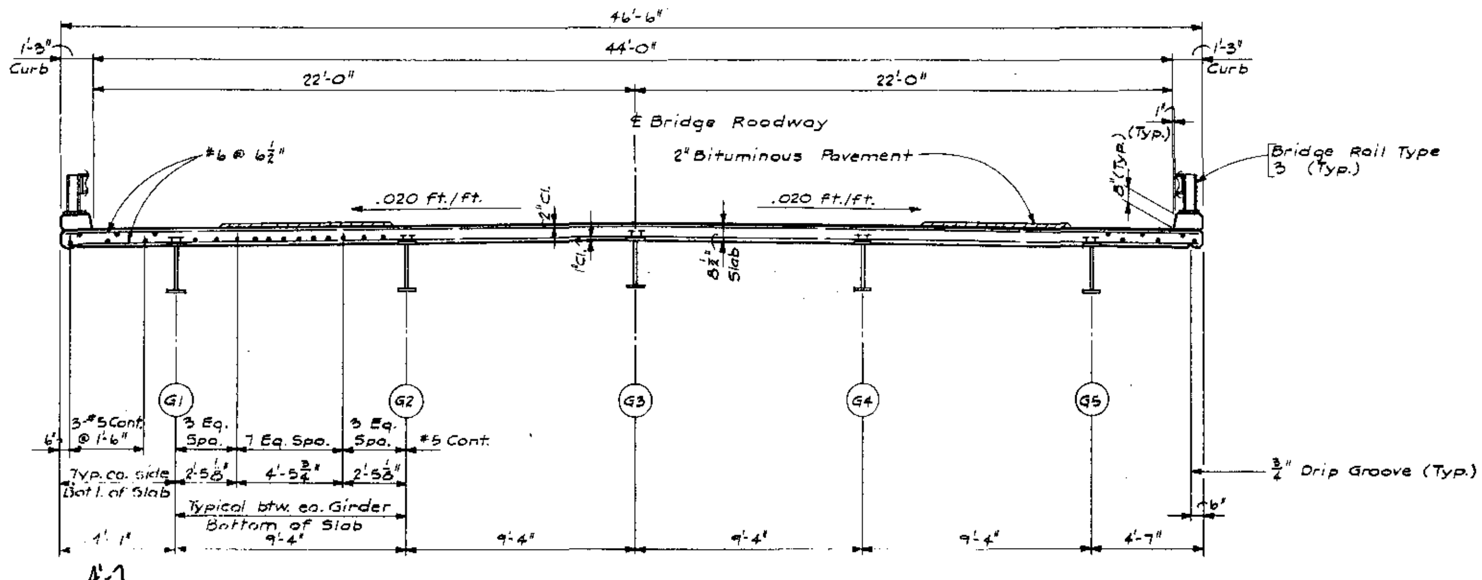
AS CONSTRUCTED
NO REVISIONS 6-1-77 REVISED VOID



SLAB PLAN



TYPICAL LONGITUDINAL SECTION THRU SLAB



TYPICAL SECTION

NOTES:

1. For Curb Reinforcing, See Dwg. No. B-14.

DIVISION OF HIGHWAYS
IHLENFELDT, PETERSON & HANEY, INC.
STRUCTURAL ENGINEERS

SLAB DETAILS

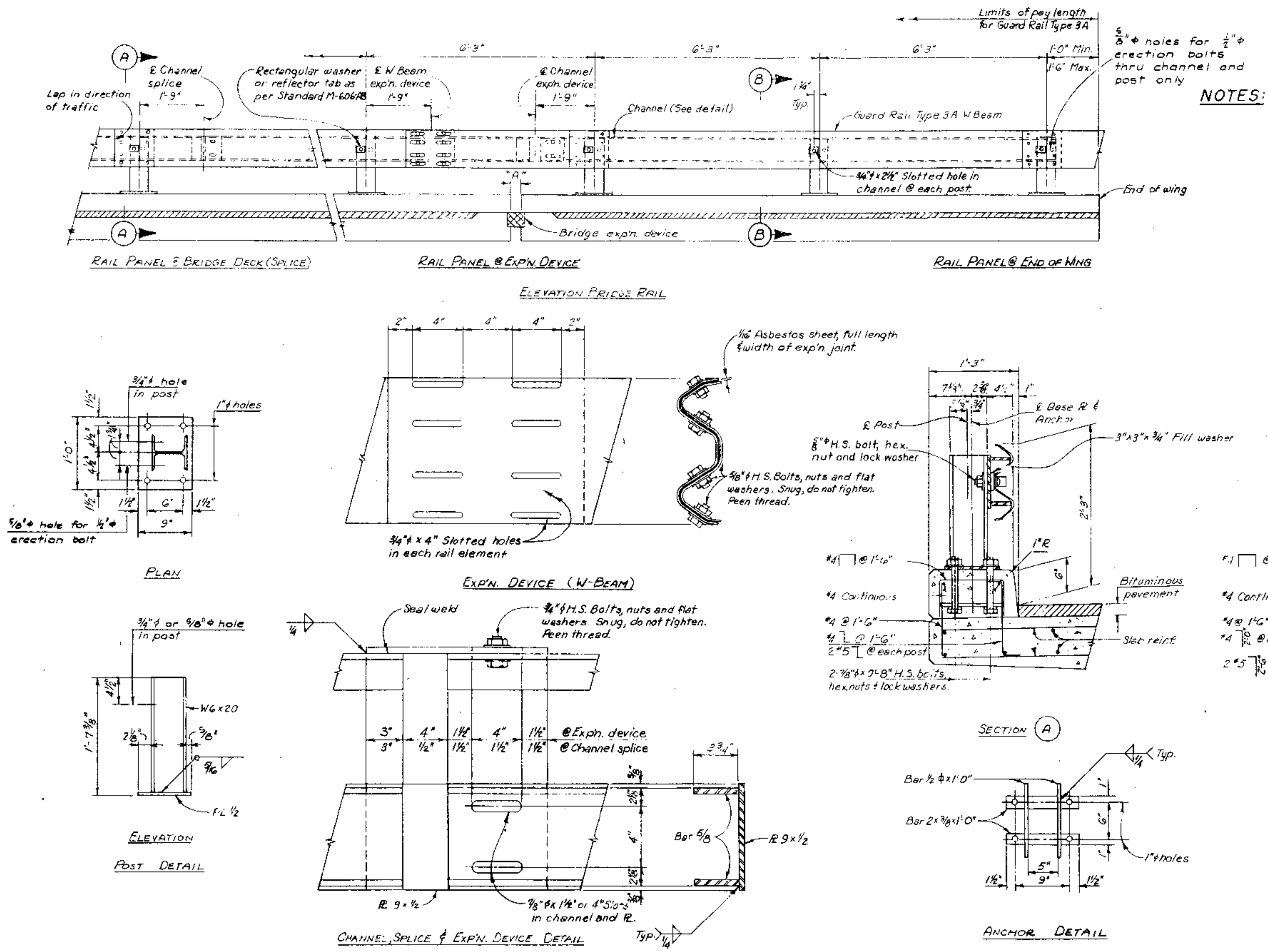
Designer Structure Numbers C-9-AR
Detailer B. Walton
Drawing Number B 13 of 15 Drawings

FEDERAL ROAD REGION NO.	DIVISION	PROJ. NO.	SHEET NO	TOTAL SHEETS
VIII	COLORADO	RS 0131(7)	19	

REVISIONS

AS CONSTRUCTED

NO REVISIONS 6-1-77 REVISED VOID



NOTES:

POSTS SHALL BE PERPENDICULAR TO THE GRADE OF THE DECK.

ALL POSTS, CHANNEL, CHANNEL SPLICE, EXPANSION DEVICE, ANCHOR ASSEMBLY, BOLTS, NUTS AND WASHERS SHALL BE GALVANIZED AFTER FABRICATION IN ACCORDANCE WITH THE SPECIFICATIONS AND SHALL BE MEASURED AND PAID FOR IN ACCORDANCE WITH SECTION 509.

CHANNEL SHALL BE CONTINUOUS OVER NOT LESS THAN TWO (2) POSTS.

POSTS AT EXPANSION JOINT SHALL BE 1'-9" MINIMUM FROM THE CENTER LINE OF THE JOINT TO THE CENTER LINE OF POST MEASURED ALONG THE CENTER LINE OF POSTS.

ONE OR MORE 6'-3" PANELS MAY BE REDUCED (5'-0" MIN.) IN ORDER TO MAINTAIN DIMENSIONS FROM THE END OF WINGS AND EXPANSION JOINTS.

ALL EXPOSED CORNERS SHALL BE GROUND SMOOTH.

SEE STANDARD M-606-AB FOR ADDITIONAL DETAILS.

THE BACKING CHANNEL SHALL BE SHOP BENT OR FABRICATED TO FIT HORIZONTAL CURVE WHEN THE RADIUS IS LESS THAN 1500 FEET.

"GUARD RAIL TYPE 3A W BEAM" SHALL BE SHOP BENT OR FABRICATED TO FIT HORIZONTAL CURVE WHEN THE RADIUS IS LESS THAN 150 FEET.

DESIGNED BY		CHECKED BY	
CHECKED BY		QUANTITIES BY	
DETAILED BY	JRE	CHECKED BY	12-73

DIVISION OF HIGHWAYS

IHLENFELDT, PETERSON & HANEY, INC. STRUCTURAL ENGINEERS

BRIDGE RAIL TYPE 3

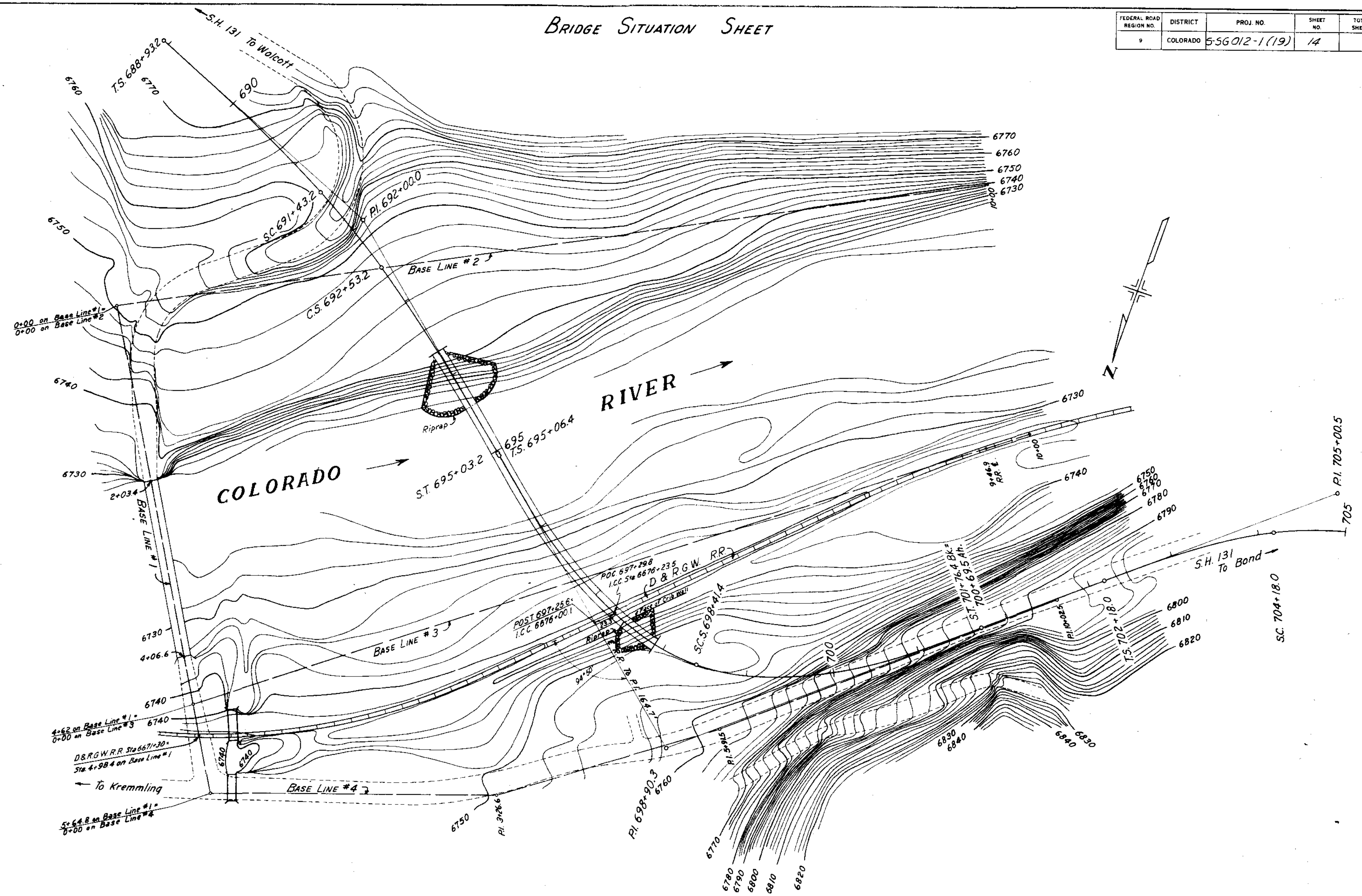
Designer J. Gravina
Detailer J.R. Ewert
Structure Numbers C-9-AR
Drawing Number B 14 of 15 Drawings

(12-17-75)

DEPARTMENT OF HIGHWAY[illegible]ATE OF COLORADO
FORM [illegible] 126
MARCH 1964

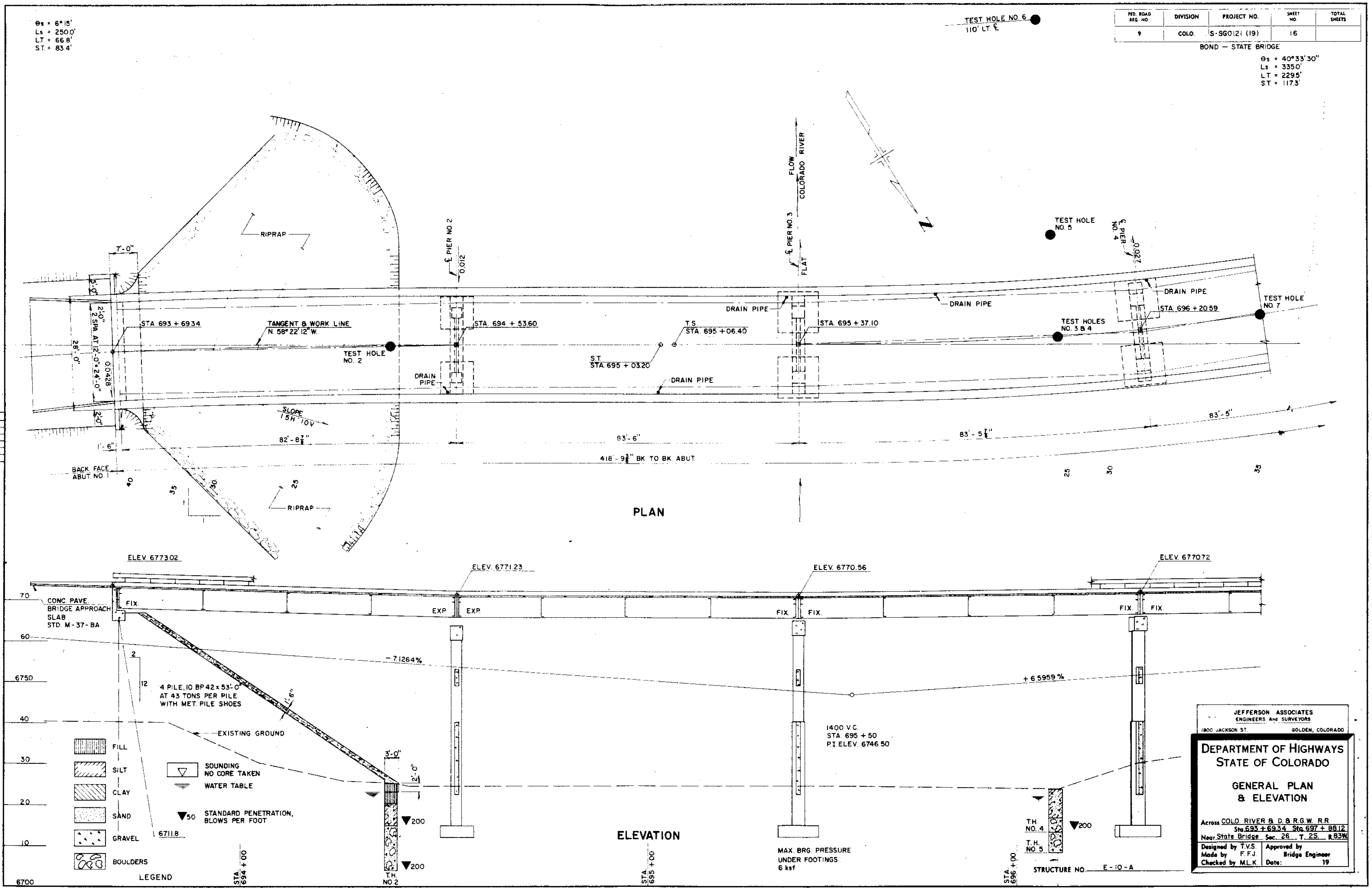
BRIDGE SITUATION SHEET

FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO	S-SG 012-1 (19)	14	



REVISIONS

REVISIONS



JEFFERSON ASSOCIATES
ENGINEERS And SURVEYORS
1800 JACKSON ST. GOLDEN, COLORADO

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO

GENERAL PLAN & ELEVATION

Across COLO. RIVER & D. & R.G.W. R.R.
Sta. 693 + 69.34 Sta. 697 + 88.12
Near State Bridge Sec. 26 T. 2S. R. 83W.

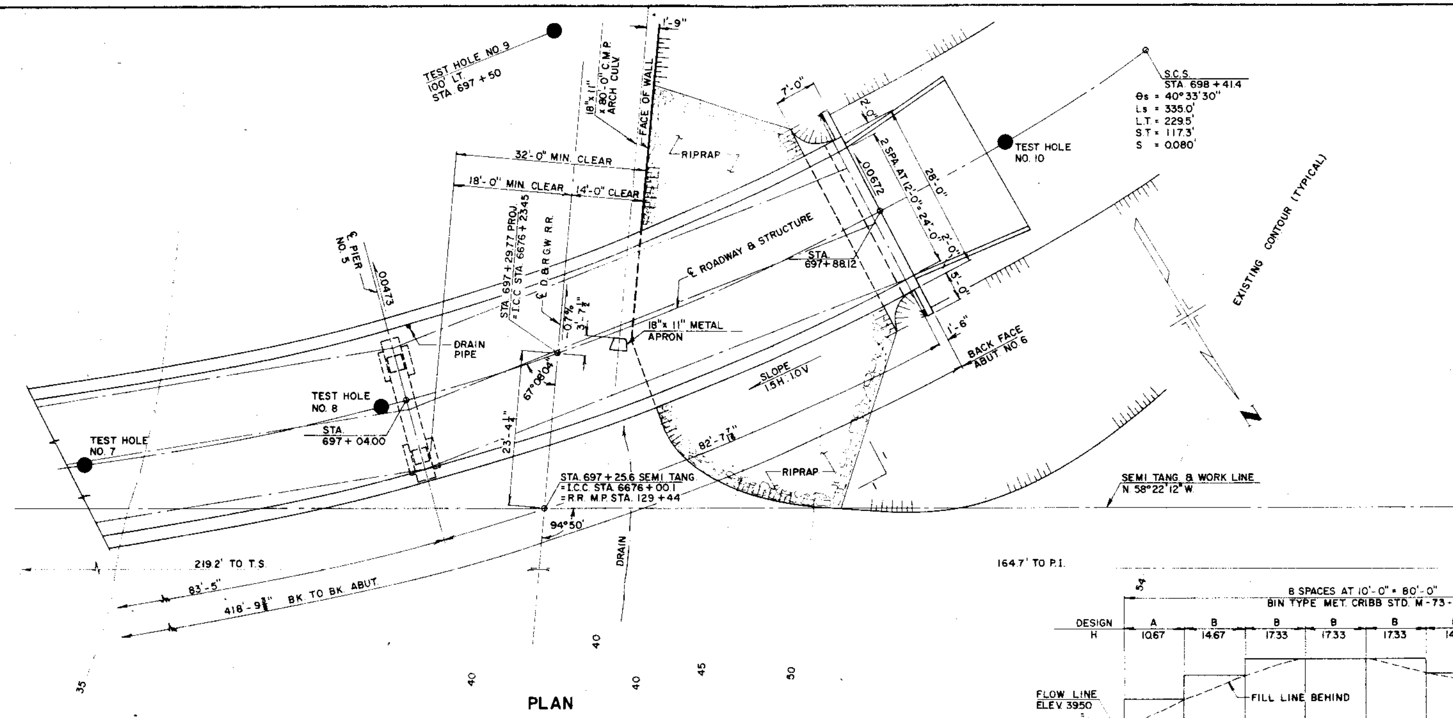
Designed by T.V.S.	Approved by
Made by F.F.J.	Bridge Engineer
Checked by M.L.K.	Date: 19

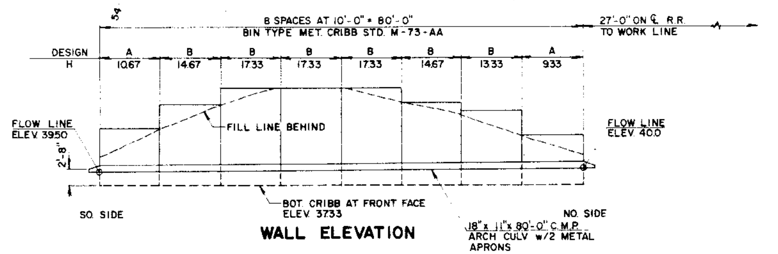
REVISIONS

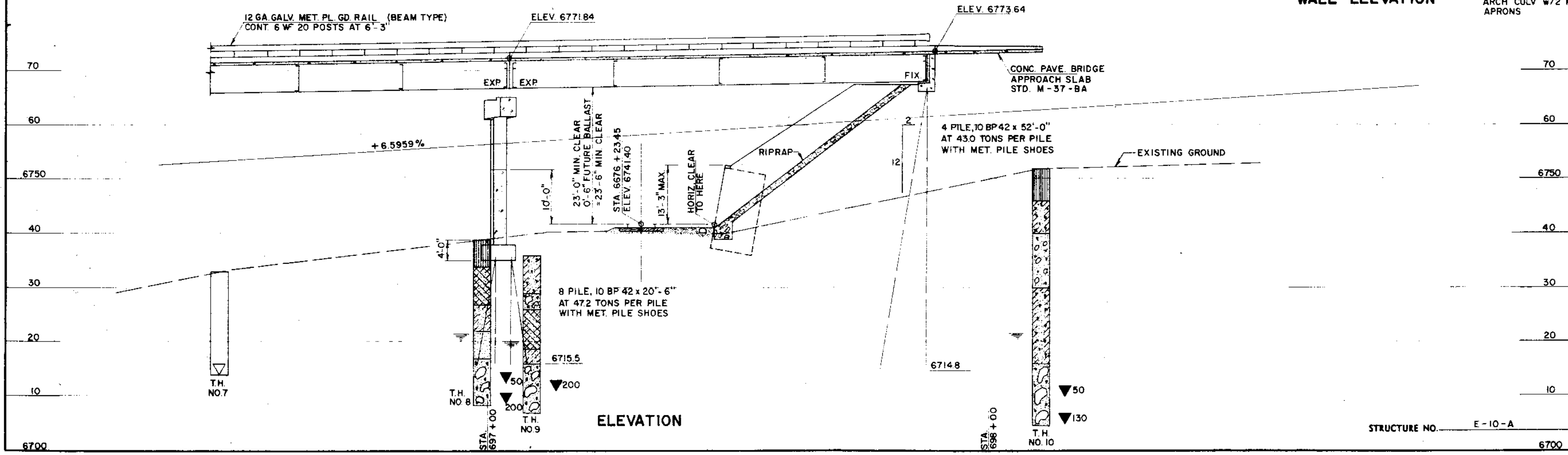
REVISIONS

FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	S-SG 0121 (19)	17	

BOND - STATE BRIDGE







STRUCTURE NO. E-10-A

JEFFERSON ASSOCIATES
ENGINEERS And SURVEYORS
1800 JACKSON ST. GOLDEN, COLORADO

DEPARTMENT OF HIGHWAYS STATE OF COLORADO

GENERAL PLAN & ELEVATION

Across COLO. RIVER & D.& R.G.W. R.R.
Sta. 693 + 69.34 – Sta. 697 + 88.12
Near State Bridge Sec. 26 T. 2S R. 83W

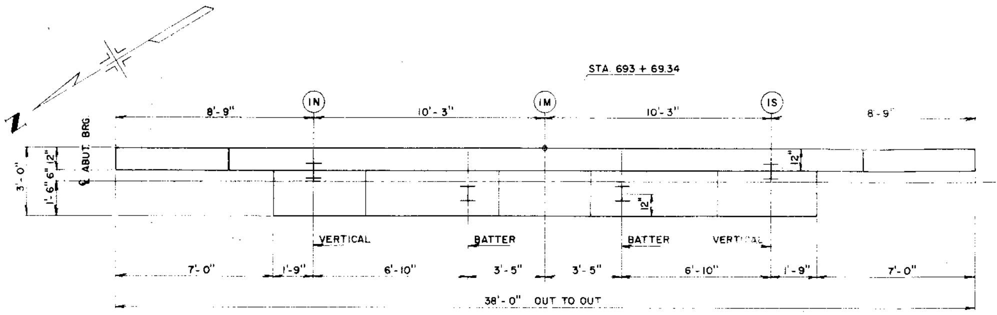
Designed by T.V.S. Made by F.F.J. Checked by M.L.K.	Approved by Bridge Engineer Date: 19

REVISIONS

REVISIONS

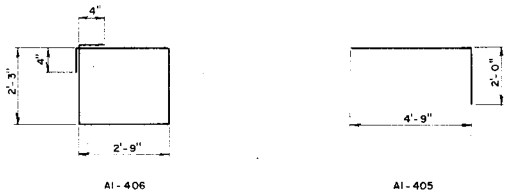
FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	S-SG0121 (19)	18	

BOND - STATE BRIDGE



PLAN

REQUIRED THIS ABUT.
3 MASONRY BEARING ℄ M2

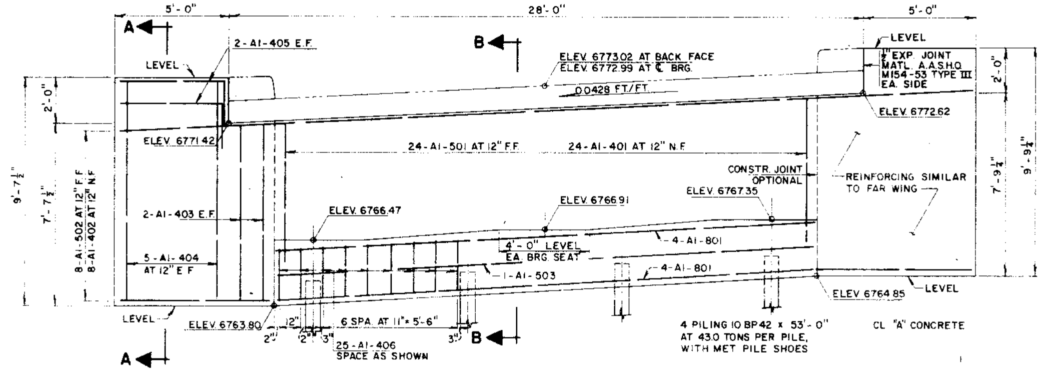


BAR BENDING DETAILS

BAR LIST				
MARK	SIZE	SHAPE	NO. REQD.	LENGTH
A1-401	4		24	6'-3"
402	4		8	37'-9"
403	4		8	7'-6"
404	4		20	9'-6"
405	4		8	6'-9"
406	4		25	10'-8"
A1-501	5		24	6'-3"
502	5		8	37'-9"
503	5		1	23'-9"
A1-801	8		8	23'-9"

BAR SUMMARY

1067 L.F. #4	AT	0.668 #/FT.	=	715
476 L.F. #5	AT	1.043 #/FT.	=	495
190 L.F. #8	AT	2.670 #/FT.	=	510
		TOTAL	=	1720 LB.

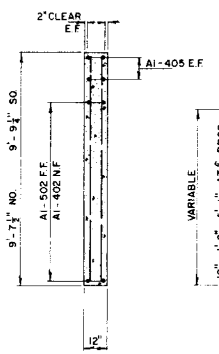


ELEVATION

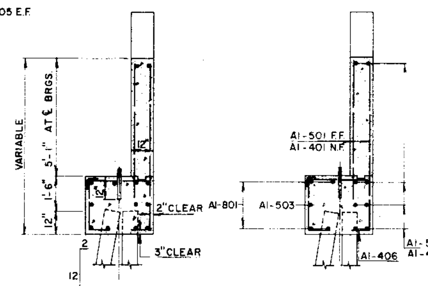
SUMMARY OF QUANTITIES					
	ITEM	UNIT	DESCRIPTION	AMOUNT
	14	CU. YD.	UNC. STR. EXCAV. (BRIDGES)	29
	16	CU. YD.	STR. BACKFILL	10
	46	CU. YD.	CL. "A" CONCRETE	140
	47	LB.	REINF. STEEL	1720
①	48	L.S.	STR. STEEL	—
	~~60~~	~~EA.~~	~~METAL PILE SHOES~~	~~4~~
	61	LIN. FT.	STEEL PILING 10 BP 42	212
②	—	SQ. FT.	½" EXP. JT. MATL.	28

① DESIGN WEIGHT = 299 LB.

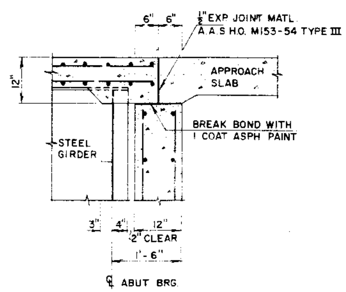
② NOT A PAY ITEM. PAYMENT SHALL BE INCLUDED IN UNIT BID PRICE FOR ITEM 46



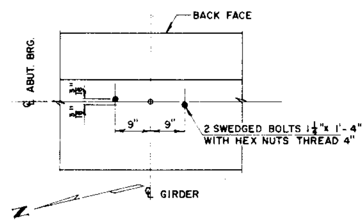
SECTION A-A



SECTION B-B



DETAIL AT TOP OF BACKWALL



ANCHOR BOLT TEMPLATE

JEFFERSON ASSOCIATES
ENGINEERS And SURVEYORS
1800 JACKSON ST. GOLDEN, COLORADO

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO

DETAILS
ABUTMENT NO. 1

Across COLO. RIVER & D. & R.G.W. R.R.
Sta. 693 + 69.34 - Sta. 697 + 88.12
Near State Bridge Sec. 26 T. 2S R. 83W.

Designed by T.V.S.	Approved by
Made by F.F.J.	Bridge Engineer
Checked by L.H.C.	Date: 19

STRUCTURE NO. E-10-A

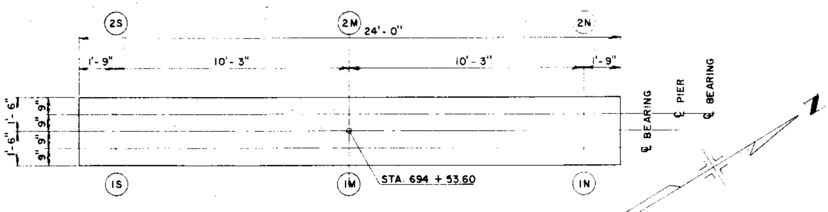
REVISIONS

REVISIONS

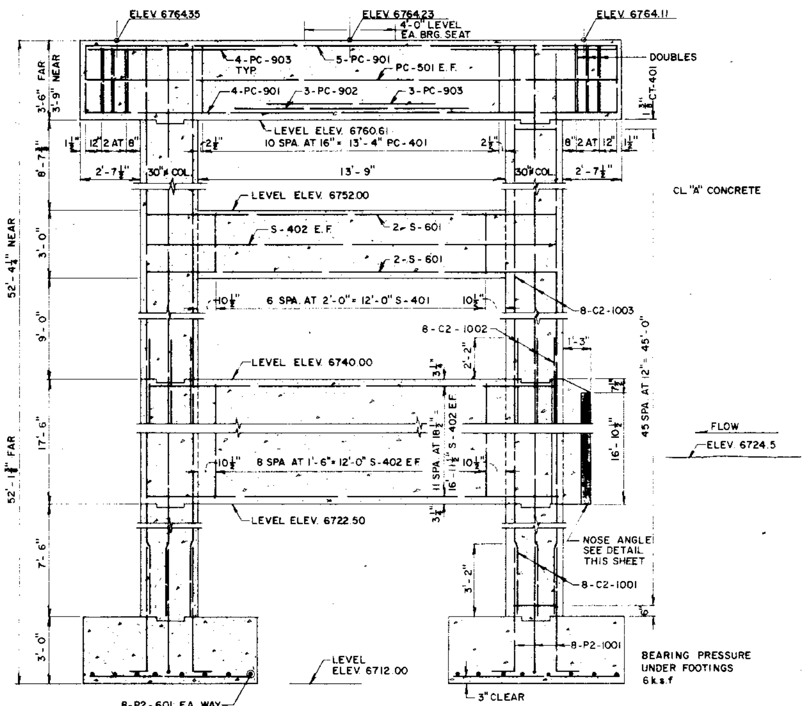
FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	S-SG0(21) (19)	19	

BOND - STATE BRIDGE

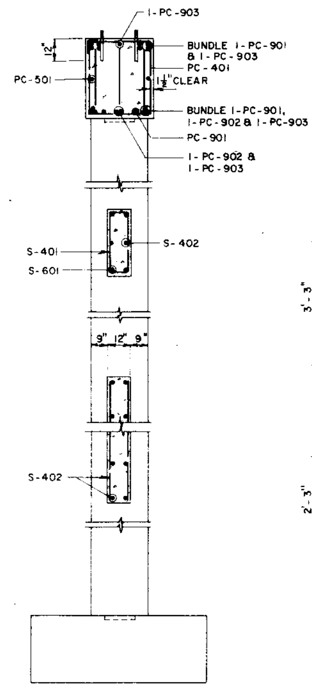
REQUIRED THIS PIER
6 MASONRY BRG. ℞ MI
6 ROCKERS RI



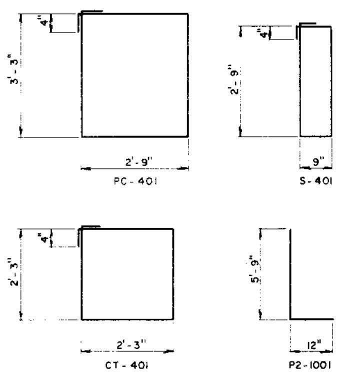
CAP BEAM PLAN



ELEVATION



SECTION



BAR BENDING DETAILS

BAR LIST

MARK	SIZE	SHAPE	NO. REQD.	LENGTH
CT-401	4		92	9'-8"
PC-401	4		25	12'-8"
S-401	4		7	7'-8"
S-402	4		44	17'-3"
PC-501	5		2	23'-9"
P2-601	6		32	7'-3"
S-601	6		4	18'-6"
PC-901	9		9	23'-9"
PC-902	9		3	10'-6"
PC-903	9		11	7'-6"
P2-1001	10		16	6'-9"
C2-1001	10		16	25'-0"
C2-1002	10		16	4'-4"
C2-1003	10		16	24'-0"

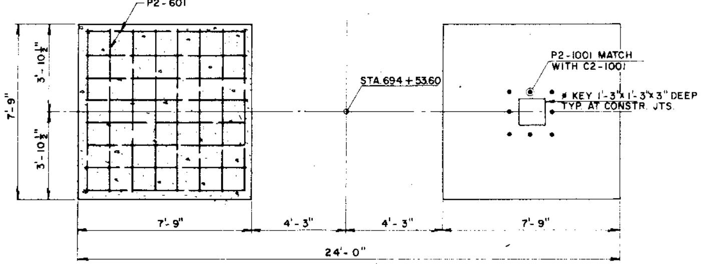
BAR SUMMARY

2020 L.F. #4 AT 0.668 #/FT. = 1350
48 L.F. #5 AT 1.043 #/FT. = 50
306 L.F. #6 AT 1.502 #/FT. = 460
328 L.F. #9 AT 3.400 #/FT. = 1115
961 L.F. #10 AT 4.303 #/FT. = 4130
TOTAL = 7105 LB.

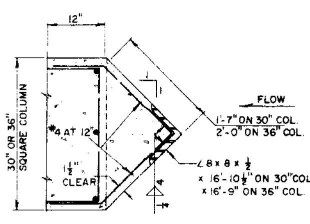
SUMMARY OF QUANTITIES

ITEM	UNIT	DESCRIPTION	AMOUNT
14	CU. YD.	UNCL. STR. EXCAV. (BRIDGES)	91
16	CU. YD.	STR. BACKFILL (CLASS X)	72
46	CU. YD.	CL. "A" CONCRETE	55
47	LB.	REINF. STEEL	7105
① 48	L.S.	STR. STEEL	—

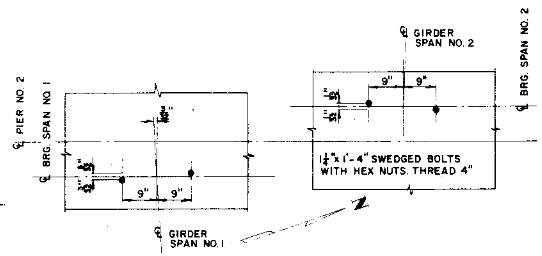
① DESIGN WEIGHT = 2400 LB.



FOOTING PLAN



NOSE ANGLE DETAIL
WEIGHT OF #4 BARS IN ASSY. INCLUDED FOR PAYMENT IN ITEM 48



ANCHOR BOLT TEMPLATE

STRUCTURE NO. E-10-A

JEFFERSON ASSOCIATES
ENGINEERS And SURVEYORS
1800 JACKSON ST. GOLDEN, COLORADO

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO

DETAILS
PIER NO. 2

Across COLO. RIVER & D. & R.G.W. R.R.
Sta. 693 + 69.34 - Sta. 697 + 88.12
Near State Bridge Sec. 26 T. 2S. R83W.

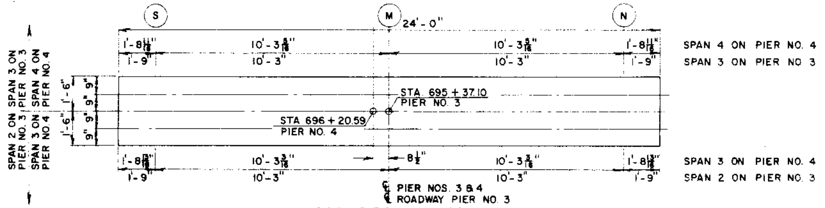
Designed by T.V.S.	Approved by
Made by F.F.J.	Bridge Engineer
Checked by L.H.C.	Date: 19

REVISIONS

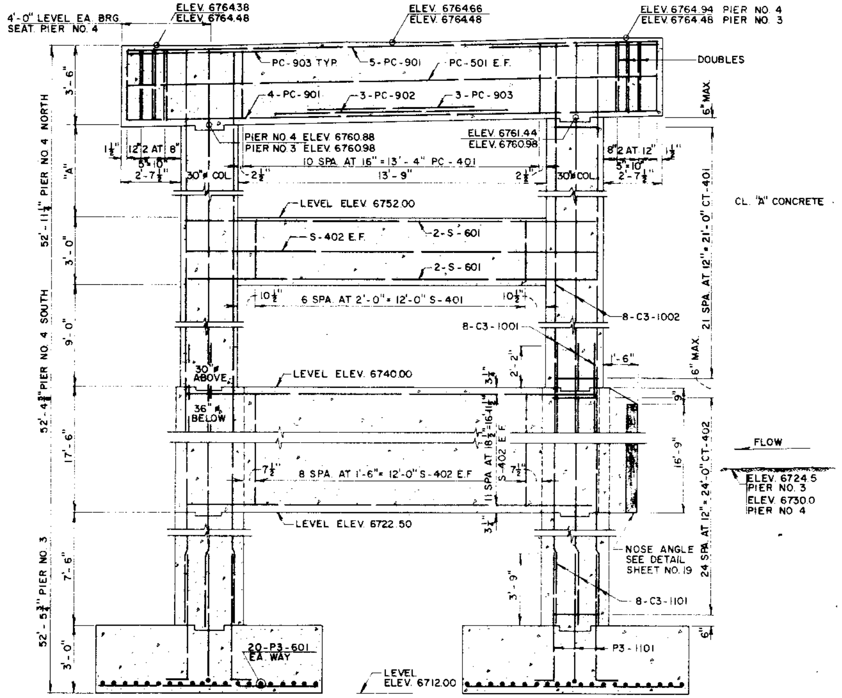
REVISIONS

FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	S-SG0121 (19)	20	

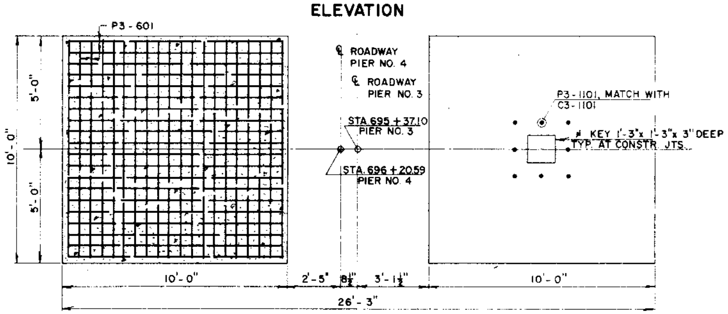
BOND - STATE BRIDGE



CAP BEAM PLAN

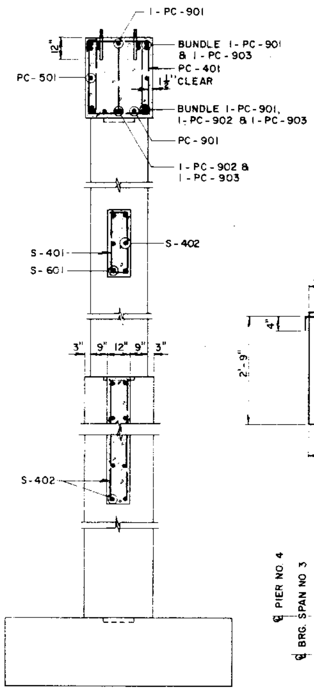


ELEVATION

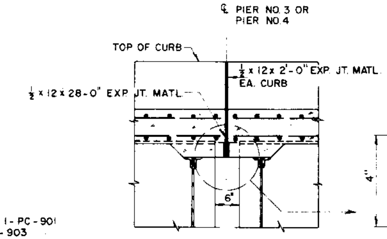


FOOTING PLAN

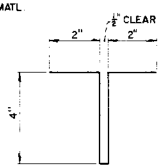
REQUIRED PIER NO. 3 & PIER NO. 4
6 MASONRY BRG. ℄ M2 EA. PIER



SECTION



SECTION C - C
SHEET NO. 26 & NO. 27

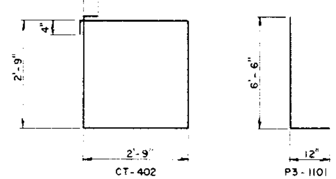


32 OZ. SHEET COPPER STIRRUP 2" LONG SPACE AT 2'-0"

PIER NO. 3 OR PIER NO. 4

BAR LIST				
MARK	SIZE	SHAPE	NO. REQD.	LENGTH
CT - 401	4		44	9'-8"
CT - 402	4		50	11'-8"
S - 401	4		7	7'-8"
PC - 401	4		25	12'-8"
S - 402	4		44	17'-6"
PC - 501	5		2	23'-9"
P3 - 601	6		80	9'-6"
S - 601	6		4	18'-6"
PC - 901	9		9	23'-9"
PC - 902	9		3	10'-6"
PC - 903	9		11	7'-6"
C3 - 1001	10		16	4'-4"
C3 - 1002	10		16	24'-0"
C3 - 1101	11		16	24'-9"
P3 - 1101	11		16	7'-6"

NOTE
SEE BAR BENDING DETAILS SHEET NO. 19

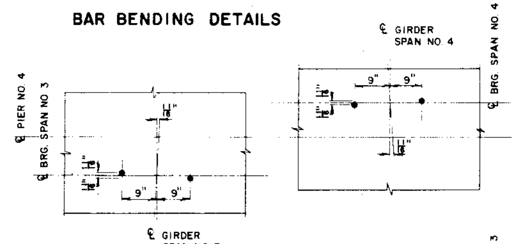


BAR BENDING DETAILS

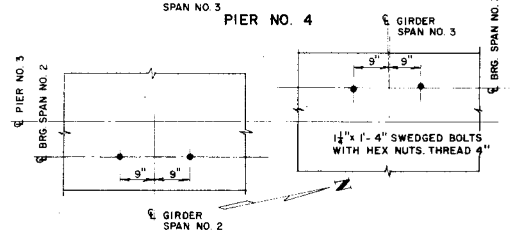
PIER NO. 3 OR PIER NO. 4

BAR SUMMARY

2150 L.F. #4 AT 0.668 #/FT. = 1435
48 L.F. #5 AT 1.043 #/FT. = 50
834 L.F. #6 AT 1.502 #/FT. = 1250
328 L.F. #9 AT 3.400 #/FT. = 1115
453 L.F. #10 AT 4.303 #/FT. = 1960
516 L.F. #11 AT 5.313 #/FT. = 2740
TOTAL = 8550 LB



PIER NO. 4



PIER NO. 3

ANCHOR BOLT TEMPLATE

PIER NO. 3 OR PIER NO. 4

SUMMARY OF QUANTITIES				
ITEM	UNIT	DESCRIPTION	NO.3 AMT.	NO.4 AMT.
14	CU. YD.	UNCL. STR. EXCAV. (BRIDGES)	115	171
16	CU. YD.	STR. BACKFILL	84	132
46	CU. YD.	CL. "A" CONCRETE	69	69
47	LB.	REINF. STEEL	8550	8550
48 ①	L.S.	STR. STEEL	—	—
80	LB.	SHEET COPPER (32 OZ.)	5	5
— ②	SQ. FT.	½" EXP. JT. MATL.	32	32

① DESIGN WEIGHT = 1546 LB. EA. PIER
② NOT A PAY ITEM. PAYMENT SHALL BE INCLUDED IN UNIT BID PRICE FOR ITEM 46.

JEFFERSON ASSOCIATES
ENGINEERS And SURVEYORS
1800 JACKSON ST. GOLDEN, COLORADO

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO

DETAILS
PIER NO. 3
PIER NO. 4

Across COLO. RIVER & D.& R.G.W. R.R.
Sta. 693 + 69.34 - Sta. 697 + 88.12
Near State Bridge Sec. 26 T. 2S. R.83W.

Designed by T.V.S. | Approved by
Made by F.F.J. | Bridge Engineer
Checked by G.D.C. | Date: 19

STRUCTURE NO. E-10-A

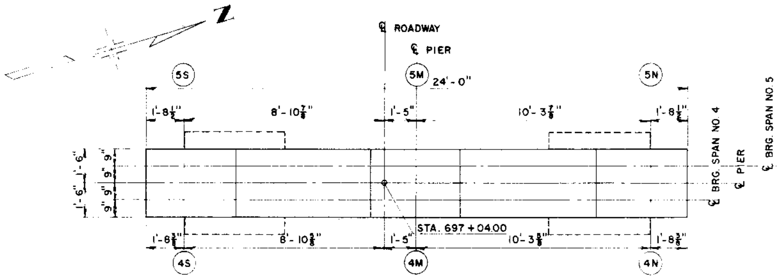
REVISIONS

REVISIONS

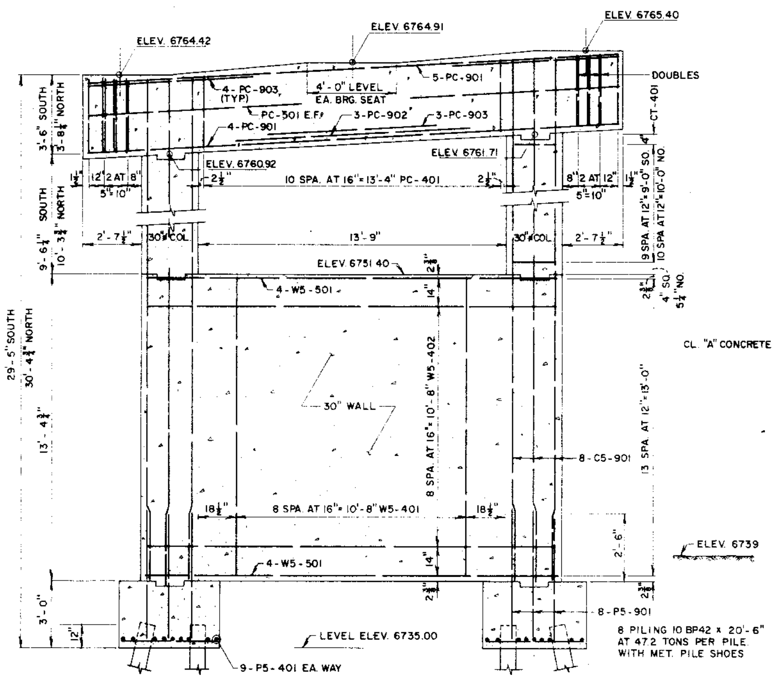
FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	S-SG 0121 (19)	21	

BOND – STATE BRIDGE

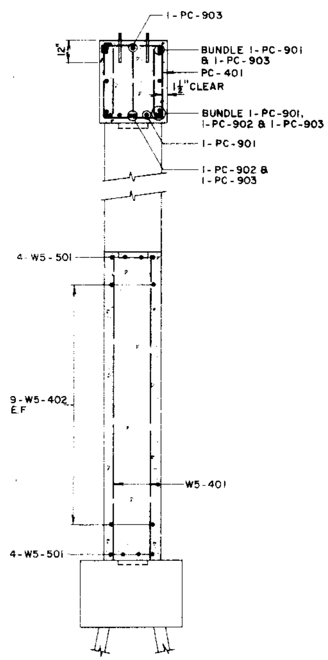
REQUIRED THIS PIER
6 MASONRY BRG. ℄ M1
6 ROCKERS R1



CAP BEAM PLAN



ELEVATION



SECTION

NOTE
SEE BAR BENDING DETAILS SHEET NO. 19

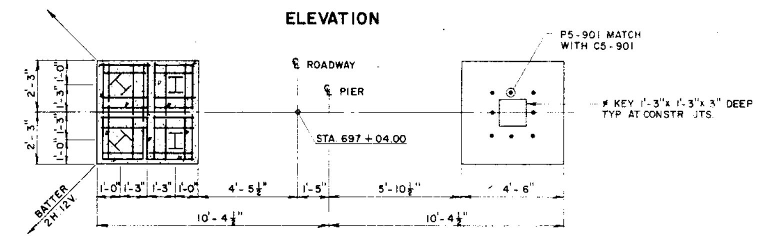
BAR LIST				
MARK	SIZE	SHAPE	NO. REQD.	LENGTH
P5-401	4		36	4'-0"
CT-401	4		49	9'-8"
PC-401	4		25	12'-8"
W5-401	4		18	13'-2"
W5-402	4		18	18'-6"
PC-501	5		2	23'-9"
W5-501	5		8	18'-6"
P5-901	9		16	5'-3"
C5-901	9		16	26'-3"
PC-901	9		9	23'-9"
PC-902	9		3	10'-6"
PC-903	9		11	7'-6"

BAR SUMMARY

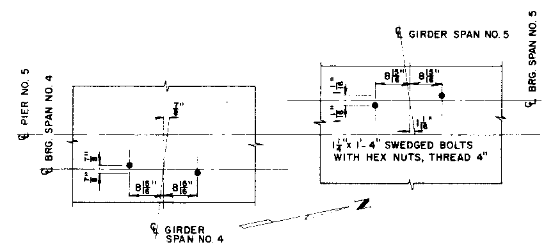
1504 L.F. #4 AT 0.668 #/FT. = 1005
196 L.F. #5 AT 1.043 #/FT. = 205
832 L.F. #9 AT 3.400 #/FT. = 2825
TOTAL = 4035 LB.

SUMMARY OF QUANTITIES				
	ITEM	UNIT	DESCRIPTION	AMOUNT
	14	CU. YD.	UNCL. STR. EXCAV. (BRIDGES)	19
	16	CU. YD.	STR. BACKFILL (CLASS X)	10
	46	CU. YD.	CL. "A" CONCRETE	43
	47	LB.	REINF. STEEL	4035
①	48	L.S.	STR. STEEL	—
	~~60~~	~~EA.~~	~~METAL PILE SHOES~~	~~8~~
	61	LIN. FT.	STEEL PILING 10BP42	164

① DESIGN WEIGHT = 2639 LB.



FOOTING PLAN



ANCHOR BOLT TEMPLATE

STRUCTURE NO. E-10-A

JEFFERSON ASSOCIATES
ENGINEERS And SURVEYORS
1800 JACKSON ST. GOLDEN, COLORADO

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO

DETAILS
PIER NO. 5

Across COLO. RIVER & D.& R.G.W. R.R.
Sta. 693 + 69.34 – Sta. 697 + 88.12
Near State Bridge Sec. 26 T. 2S R.83W.

Designed by T.V.S.	Approved by
Made by F.F.J.	Bridge Engineer
Checked by L.H.C.	Date: 19

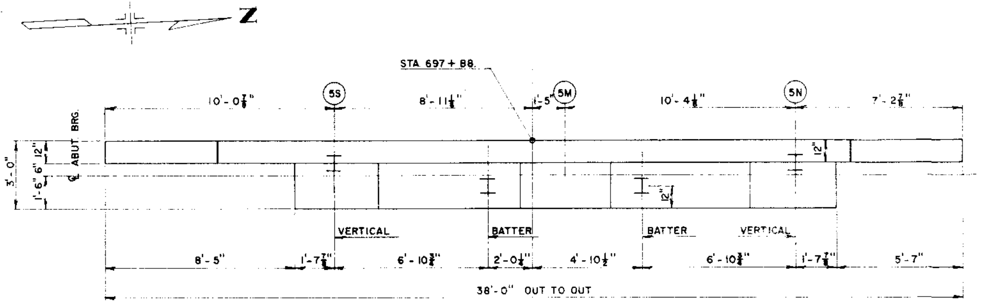
REVISIONS

REVISIONS

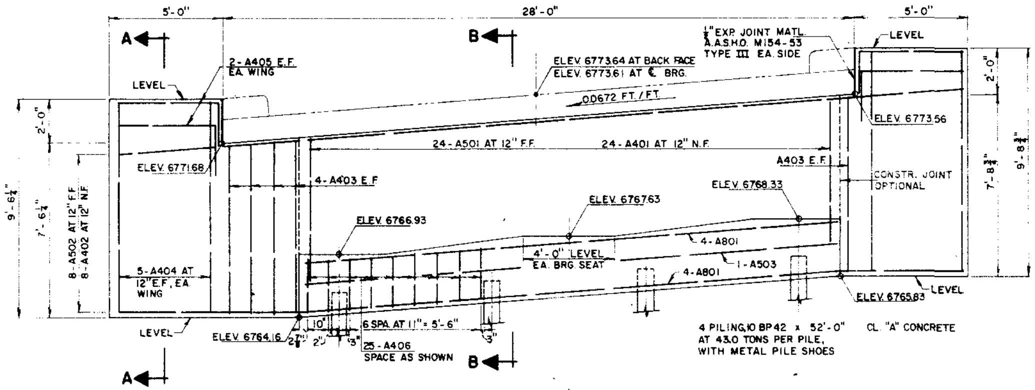
FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	S-SG 0121 (19)	22	

BOND – STATE BRIDGE

REQUIRED THIS ABUT.
3 MASONRY BRG. ℄ M2



PLAN



ELEVATION

NOTE

1. USE BAR BENDING DETAILS ABUT. NO. 1 SHEET NO. 18
2. SEE DETAIL AT TOP OF BACKWALL ABUT. NO. 1 SHEET NO. 18

BAR LIST

MARK	SIZE	SHAPE	NO. REQD.	LENGTH
A6-401	4		24	6'-3"
A6-402	4		8	37'-9"
A6-403	4		10	7'-6"
A6-404	4		20	9'-6"
A6-405	4		8	6'-9"
A6-406	4		25	10'-8"
A6-501	5		24	6'-3"
A6-502	5		8	37'-9"
A6-503	5		1	23'-9"
A6-801	8		8	23'-9"

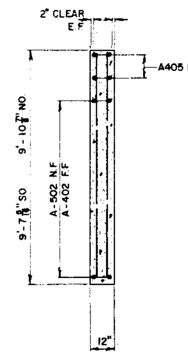
BAR SUMMARY

1082 L.F. #4 AT 0.668 #/FT. = 725
476 L.F. #5 AT 1.043 #/FT. = 495
190 L.F. #8 AT 2.670 #/FT. = 510
TOTAL = 1730 LB.

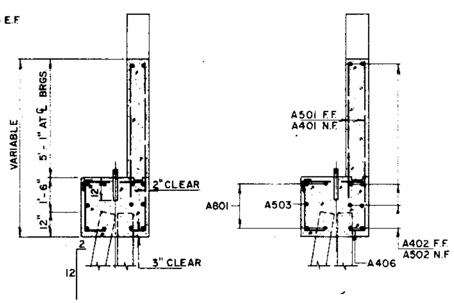
SUMMARY OF QUANTITIES

	ITEM	UNIT	DESCRIPTION	AMOUNT
	14	CU. YD.	UNCL. STR. EXCAV. (BRIDGES)	29
	16	CU. YD.	STR. BACKFILL (CLASS X)	10
	46	CU. YD.	CL. "A" CONCRETE	140
	47	LB.	REINF. STEEL	1730
①	48	L.S.	STR. STEEL	—
	~~60~~	~~EA.~~	~~METAL PILE SHOES~~	~~4~~
	61	LIN. FT.	STEEL PILING	208
②	—	SQ. FT.	1/2" EXP. JT. MATL.	28

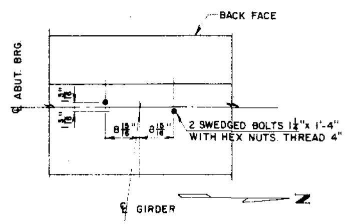
① DESIGN WEIGHT = 299 LB.
② NOT A PAY ITEM. PAYMENT SHALL BE INCLUDED IN UNIT BID PRICE FOR ITEM 46



SECTION A-A



SECTION B-B



ANCHOR BOLT TEMPLATE

STRUCTURE NO. E-10-A

JEFFERSON ASSOCIATES
ENGINEERS And SURVEYORS
1800 JACKSON ST. GOLDEN, COLORADO

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO

DETAILS
ABUTMENT NO. 6

Across COLO. RIVER & D.& R.G.W. R.R.
Sta. 693 + 69.34 - Sta. 697 + 88.12
Near State Bridge Sec. 26 T. 2S R. 83W

Designed by T.V.S. Made by F.F.J. Checked by L.H.C.	Approved by Bridge Engineer Date: 19

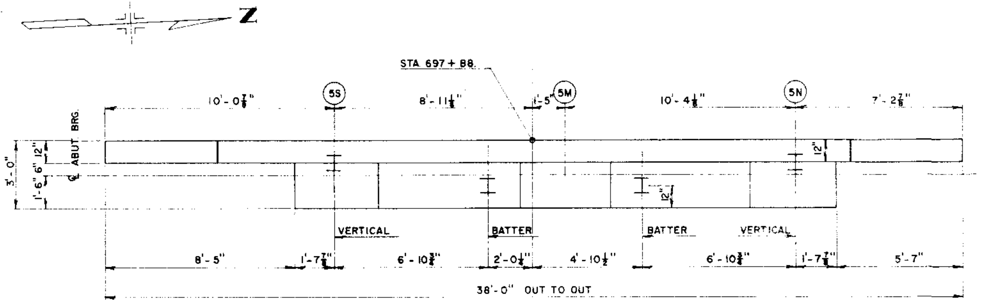
REVISIONS

REVISIONS

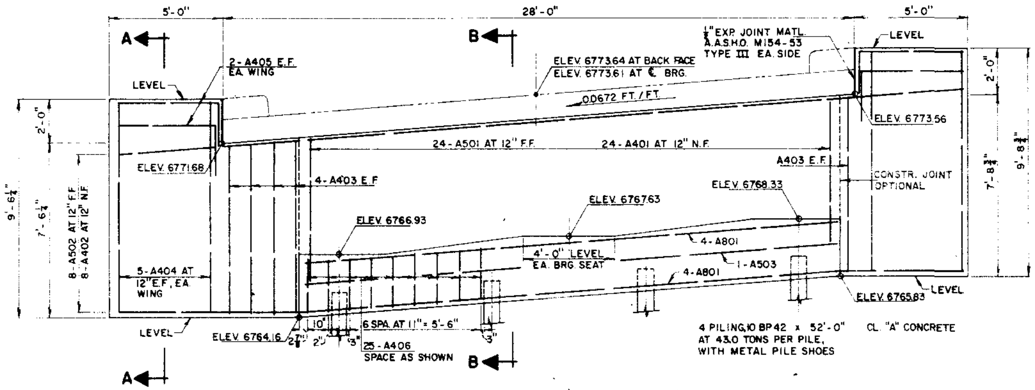
FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	S-SG 0121 (19)	22	

BOND - STATE BRIDGE

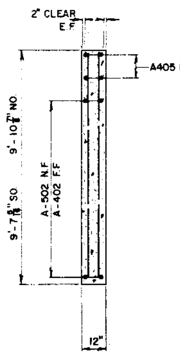
REQUIRED THIS ABUT.
3 MASONRY BRG. ℄ M2



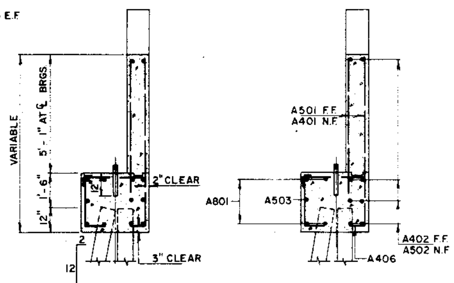
PLAN



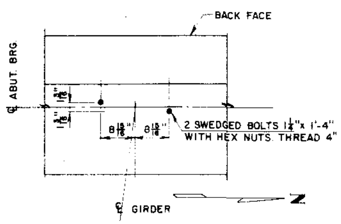
ELEVATION



SECTION A-A



SECTION B-B



ANCHOR BOLT TEMPLATE

NOTE

1. USE BAR BENDING DETAILS ABUT. NO. 1 SHEET NO. 18
2. SEE DETAIL AT TOP OF BACKWALL ABUT. NO. 1 SHEET NO. 18

BAR LIST

MARK	SIZE	SHAPE	NO. REQD.	LENGTH
A6-401	4		24	6'-3"
A6-402	4		8	37'-9"
A6-403	4		10	7'-6"
A6-404	4		20	9'-6"
A6-405	4		8	6'-9"
A6-406	4		25	10'-8"
A6-501	5		24	6'-3"
A6-502	5		8	37'-9"
A6-503	5		1	23'-9"
A6-801	8		8	23'-9"

BAR SUMMARY

1082 L.F. #4 AT 0.668 #/FT. = 725
476 L.F. #5 AT 1.043 #/FT. = 495
190 L.F. #8 AT 2.670 #/FT. = 510
TOTAL = 1730 LB.

SUMMARY OF QUANTITIES

	ITEM	UNIT	DESCRIPTION	AMOUNT
	14	CU. YD.	UNCL. STR. EXCAV. (BRIDGES)	29
	16	CU. YD.	STR. BACKFILL (CLASS X)	10
	46	CU. YD.	CL. "A" CONCRETE	140
	47	LB.	REINF. STEEL	1730
①	48	L.S.	STR. STEEL	—
	~~60~~	~~EA.~~	~~METAL PILE SHOES~~	~~4~~
	61	LIN. FT.	STEEL PILING	208
②	—	SQ. FT.	¼" EXP. JT. MATL.	28

① DESIGN WEIGHT = 299 LB.
② NOT A PAY ITEM. PAYMENT SHALL BE INCLUDED IN UNIT BID PRICE FOR ITEM 46

JEFFERSON ASSOCIATES
ENGINEERS And SURVEYORS
1800 JACKSON ST. GOLDEN, COLORADO

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO

DETAILS
ABUTMENT NO. 6

Across COLO. RIVER & D.&R.G.W. R.R.
Sta. 693 + 69.34 - Sta. 697 + 88.12
Near State Bridge Sec. 26 T. 2S R.83W

Designed by T.V.S.
Made by F.F.J.
Checked by L.H.C.
Approved by Bridge Engineer
Date: 19

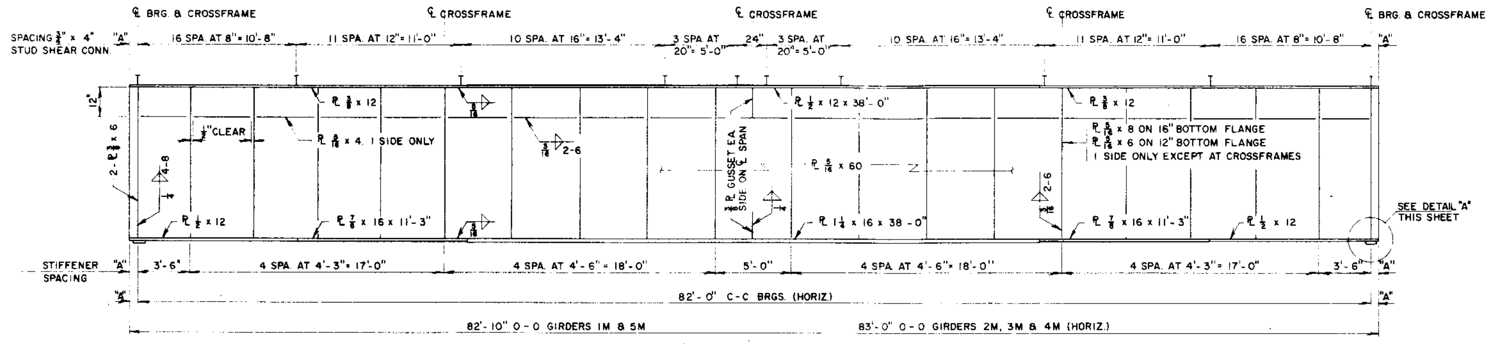
STRUCTURE NO. E-10-A

REVISIONS

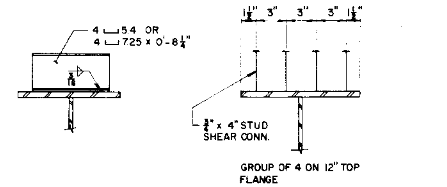
REVISIONS

FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	S-SG 0121 (19)	23	

BOND – STATE BRIDGE

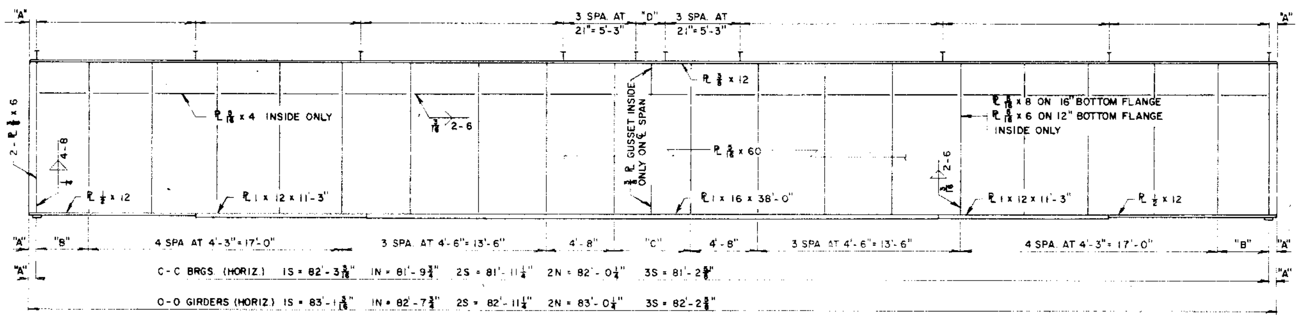


GIRDER ELEVATION
1M, 2M, 3M, 4M, & 5M

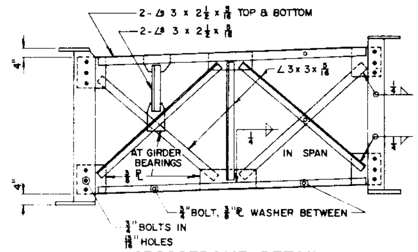


ALT. SHEAR CONNECTOR

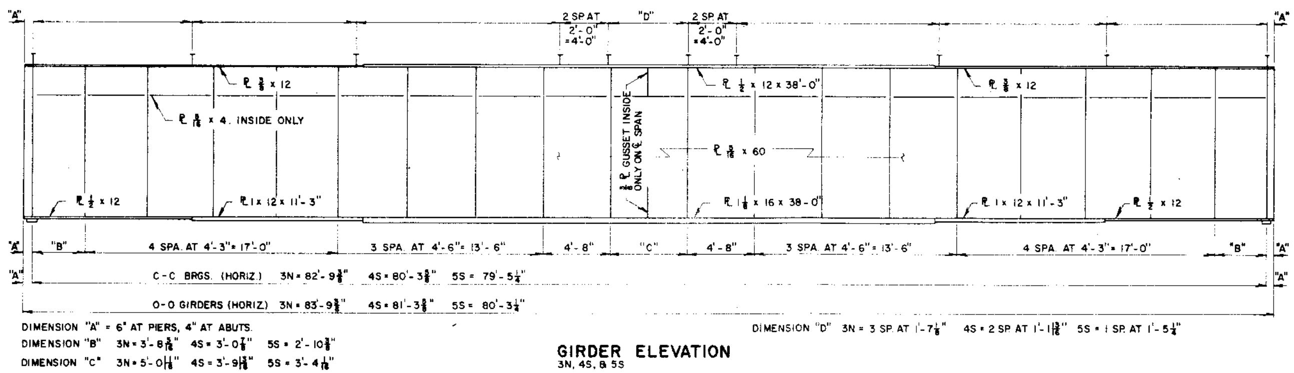
STUD SHEAR CONNECTOR LOCATION



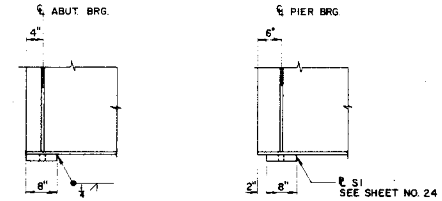
GIRDER ELEVATION
1S, 1N, 2S, 2N, & 3S



CROSSFRAME DETAIL
AT ALL LOCATIONS BETWEEN GIRDERS



GIRDER ELEVATION
3N, 4S, & 5S



AT ABUTS.

AT PIERS

DETAIL "A"

JEFFERSON ASSOCIATES
ENGINEERS And SURVEYORS
1800 JACKSON ST. GOLDEN, COLORADO

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO

GIRDER & STRUCTURAL STEEL DETAILS

Across COLO. RIVER & D. & R.G.W. R.R.
Sta. 693 + 69.34 – Sta. 697 + 88.12
Near State Bridge Sec. 26 T. 2S. R. 83W.

Designed by T.V.S. Approved by
Made by F.F.J. Bridge Engineer
Checked by G.D.C. Date: 19

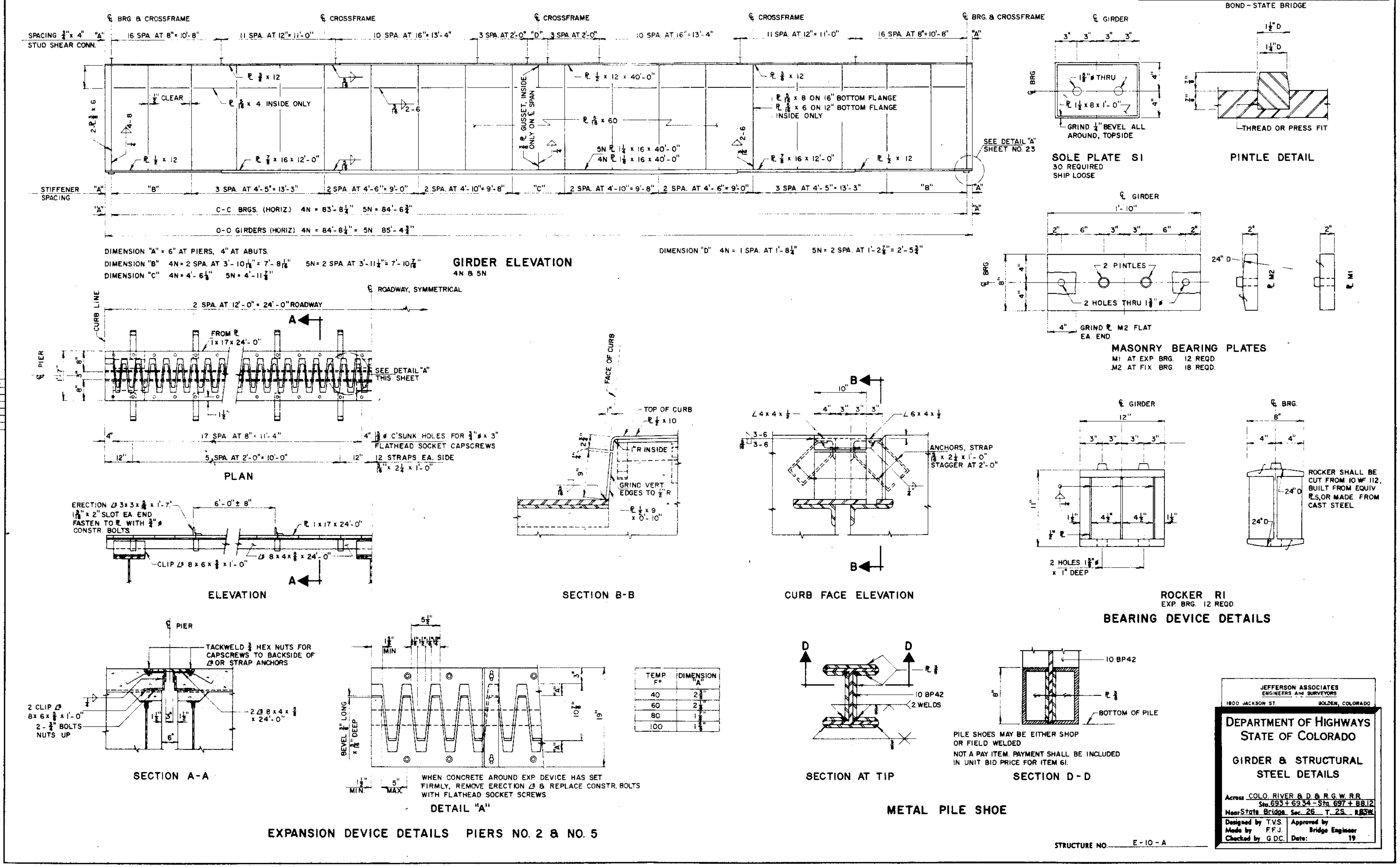
STRUCTURE NO. E-10-A

REVISIONS

REVISIONS

FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	S-SG 0121 (19)	24	

BOND - STATE BRIDGE



TEMP F°	DIMENSION "A"
40	[illegible]
60	[illegible]
80	[illegible]
100	[illegible]

JEFFERSON ASSOCIATES
ENGINEERS AND SURVEYORS
1800 JACKSON ST GOLDEN, COLORADO

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO

GIRDER & STRUCTURAL STEEL DETAILS

Across COLO. RIVER & D. & R.G.W. R.R.
Sta. 693+69.34 - Sta. 697+88.12
Near State Bridge Sec. 26 T. 2S. R. 83W.

Designed by T.V.S. Made by F.F.J. Checked by G.D.C.
Approved by Bridge Engineer
Date: 19

STRUCTURE NO. E-10-A

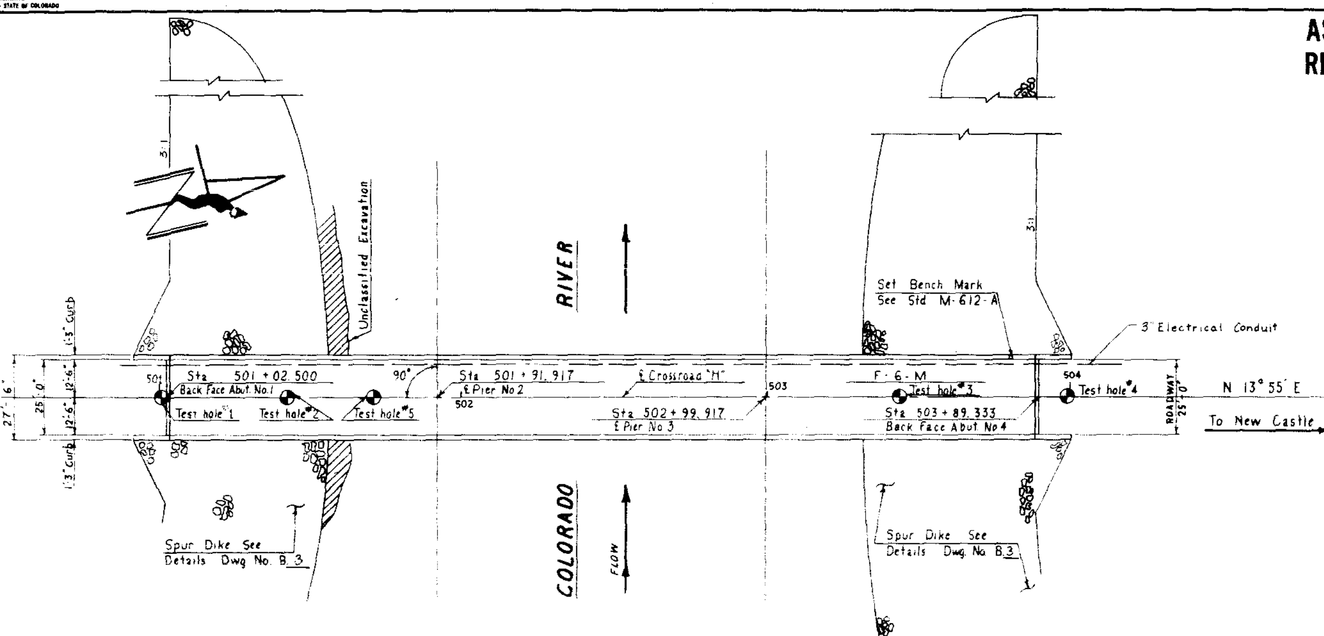
STATE DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS – STATE OF COLORADO
FORM D.O.H. 117
JULY 1968

AS CONSTRUCTED

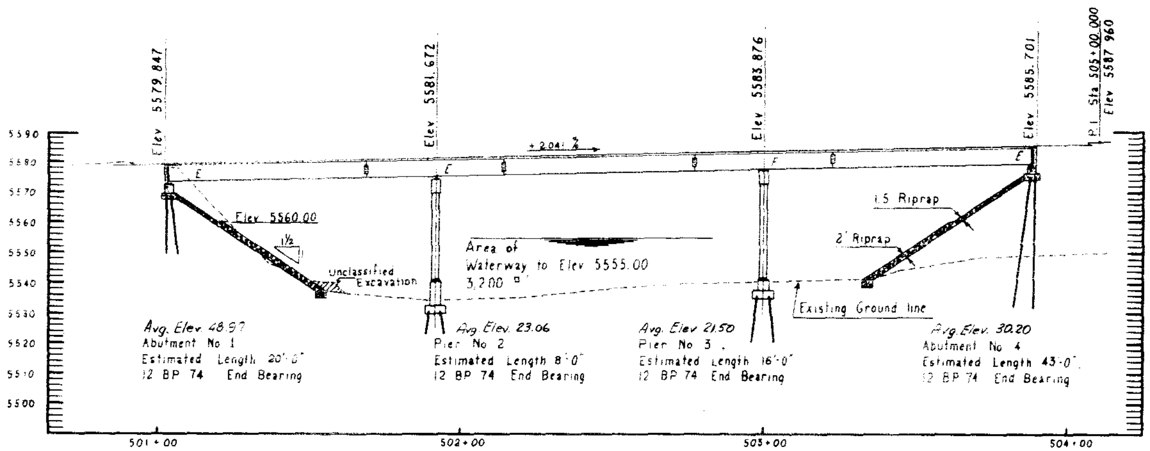
REVISED DATE DEC 23 1971

FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO	I-70-1(27)105	51	234

REVISIONS



·PLAN·



·ELEVATION·

(Taken at Center line of Bridge)

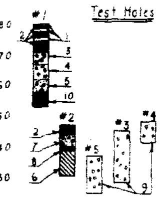
Q50 = 47,500 CFS.
DA = 6,630 Sq. Mi.

HYDRAULICS

Q 50 47,500 CFS
DA 6,630 Sq M

GENERAL LAYOUT

Test Holes



1 Soil
2 Sandstone Boulders
3 Soil, Broken Rock
4 Broken Rock, Small Boulders
5 Sandstone
6 Argillaceous Sandstone
7 River Boulders, Gravel
8 Arenaceous Shale
9 Sand, Gravel, Boulders
10 Fractured Standstone

For Summary of Quantities see Dwg. No. B-2
For Riprap Details see Dwg No B-3

3-Spans (87'-6" - 108'-0" - 87'-6") Continuous Concrete Slab and Welded Steel Girder Bridge.

Crossroad "H" over Colorado River
Roadway: 25'-0" Skew: 90°
1'-3" Curbs, Std Galvanized Bridge Rail

GENERAL NOTES

ALL WORK SHALL BE DONE ACCORDING TO THE STANDARD SPECIFICATIONS OF THE DEPARTMENT OF HIGHWAYS, STATE OF COLORADO, APPLICABLE TO THE PROJECT.

EACH REINFORCING BAR SHALL BE TAGGED WITH THE BAR DESIGNATION, STRUCTURE NUMBER, AND STATION OF THE PROJECT.

IF BY PERMISSION OF THE ENGINEER PRIMARY BARS ARE SPLICED, THEY SHALL LAP A MINIMUM OF 40 DIAMETERS FOR BARS NEAR TOPS OF BEAMS HAVING MORE THAN 12 INCHES OF CONCRETE UNDER THE BARS, AND 24 DIAMETERS FOR BARS NEAR THE BOTTOMS OF MEMBERS. SECONDARY BARS SHALL LAP 24 DIAMETERS WHEN SPLICED.

DIMENSIONS FOR REINFORCING STEEL NOT SHOWN AS CLEAR SHALL BE TO THE CENTERLINE OF THE BAR.

ALL CONCRETE SURFACES MARKED WITH THE SYMBOL AS SHOWN ON DRAWING NO. B-3 SHALL RECEIVE CLASS 2 SURFACE FINISH.

ALL CONCRETE CHAMFERS SHALL BE 3/4" UNLESS OTHERWISE NOTED.

EXPANSION JOINT MATERIAL SHALL MEET AASHO SPECIFICATION M-213-65 UNLESS OTHERWISE NOTED.

SOUNDINGS AND DEPTH OF FOOTINGS ARE IN ACCORDANCE WITH THE BEST AVAILABLE DATA. WHEN DIFFERENT CONDITIONS ARE ENCOUNTERED, THE BRIDGE ENGINEER WILL INSPECT AND DETERMINE IF REDESIGN IS NECESSARY.

WHEN TREATED TIMBER PILING IS SHOWN ON THE PLANS, THE PRESERVATIVE FOR TREATMENT SHALL BE CREOSOTE OIL.

WHEN EXCAVATING FOR FOOTINGS THE FINAL SIX INCHES IN DEPTH SHALL BE DONE BY HAND-LABOR METHODS.

FOR DETAILS OF STRUCTURE EXCAVATION AND STRUCTURE BACKFILL, SEE STANDARD M-206-A.

ALL STRUCTURAL STEEL NOT OTHERWISE NOTED SHALL BE AASHO SPECIFICATION M-183.

WELDING SHALL CONFORM TO THE LATEST EDITION OF THE AWS STANDARD SPECIFICATIONS FOR WELDING HIGHWAY BRIDGES AS AMENDED.

FOR WELDED GIRDERS, ALL SHOP BUTT WELDS IN FLANGES AND WEBS SHALL BE MADE BEFORE WELDING INTO GIRDER. SHOP WELDS SHALL BE INSPECTED RADIOGRAPHICALLY OR BY THE PENETRANT DYE METHOD.

ALL STRUCTURAL STEEL NOT OTHERWISE NOTED SHALL BE PAINTED IN ACCORDANCE WITH SECTION 509 FOR (GREEN) PAINT.

NO WELDING OF ANY KIND SHALL BE PERMITTED ON THE FLANGES OF STEEL GIRDERS UNLESS SPECIFICALLY CALLED FOR ON THE PLANS.

BOLTS SHALL BE FURNISHED IN THE AMOUNT OF TWO PERCENT IN EXCESS OF THE NOMINAL NUMBER REQUIRED FOR EACH SIZE AND LENGTH.

ALL BOLTS SHALL BE 3/4" DIAMETER, HIGH-TENSILE STRENGTH UNLESS OTHERWISE NOTED.

LOADING DATA

LIVELOAD: AASHO HS-20-44

DEADLOAD: ASSUMES 15 LBS. PER SQ. FT. ADDITIONAL WEARING SURFACE WHICH INCLUDES THE ½ INCH CONCRETE MONOLITHIC WEARING SURFACE SHOWN.

DESIGN DATA

AASHO UNIT STRESSES EXCEPT AS NOTED.

REINFORCING STEEL: GRADE 40 Fs = 20,000 LBS. PER SQ. IN.; GRADE 60 Fs = 24,000 LBS. PER SQ. IN.

STRUCTURAL STEEL: A36, Fs = 20,000 LBS. PER SQ. IN.; A572, Fs = 27,000 LBS. PER SQ. IN.

CONCRETE: Fc = 1,200 LBS. PER SQ. IN.; n = 10

FEB 1971 BRIDGE SECT. D.O.H.

Rev. PC 2-18-70

PLANS BY BSMcH & D.O.H.

DIVISION OF HIGHWAYS

GENERAL NOTES
GENERAL LAYOUT

STATION: 501+02.500 TO 503+89.333
NEAR: NEW CASTLE SEC. 2-32 T 5-6 S R 90-91 W

Approved:	Designer: P. W. G. Detailer: Seylhouse
Bridge Engineer	Structure Numbers: F-6-M
Date	DWG. No. B 1 OF 11

DESIGNED BY	F. W. G.	8-69
CHECKED BY	R. J. S.	8-69
DETAILED BY	R. W. G.	B-69
CHECKED BY	D. R.	B-69
QUANTITIES BY	D. R.	B-69
CHECKED BY	D. R.	B-69

STATE DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS — STATE OF COLORADO
FORM D.O.H. 117
JULY, 1968

AS CONSTRUCTED
REVISED DATE DEC 23 1971

FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO	I-70-1(27) 105	52	234

REVISIONS

Bar List - Pier No. 2

MARK	NO. REQ'D	LENGTH	TYPE	DIMENSIONS l	DIMENSIONS m
415	4	2'-9"	Str		
416	4	2'-6"	VIII		
417	6	6'-3¾"	VII	1'-4½"	4'-3¾"
418	14	2'-8"	Str		
420	87	9'-5"	II	1'-11½"	2'-3"
421	58	5'-6½"	VII	1'-1½"	3'-6½"
422	16	7'-1¼"	VII	1'-7½"	5'-1¼"
423	16	12'-5"	II	2'-5½"	3'-3"
506	12	14'-4"	II	4'-3"	2'-5"
507 to 513	4 ea.	14'-1" B.E.I. 11'-9½"	II	4'-1½" B.E.I. 2'-11¾"	2'-5"
514	27	6'-6"	Str		
80[illegible]		14'-8"			
[illegible]	4	[illegible]			
[illegible]	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]			
[illegible]	2	[illegible]			
[illegible]	26	[illegible]			
[illegible]	54	[illegible]			
[illegible]	28	[illegible]	Str		

Summary

[illegible] Lin Ft #4 Bar @ [illegible] Lbs/Lin Ft = [illegible] Lbs
[illegible] Lin Ft #5 Bar @ 1.043 Lbs/Lin Ft = [illegible] Lbs
[illegible] Lin Ft #6 Bar @ 2.670 Lbs/Lin Ft = 430 Lbs
78 Lin Ft #7 Bar @ [illegible] Lbs/Lin Ft = [illegible] Lbs
45 Lin Ft #[illegible] Bar @ [illegible] Lbs/Lin Ft = [illegible] Lbs
Total = [illegible] Lbs

Bar List - Pier No. 3

MARK	NO. REQ'D	LENGTH	TYPE	DIMENSIONS l	DIMENSIONS m
415	4	2'-9"	Str		
416	4	2'-6"	VIII		
417	6	6'-3¾"	VII	1'-4½"	4'-[illegible]¾"
418	14	2'-8"	Str		
420	36	9'-5"	II	1'-11½"	2'-3"
421	64	5'-6½"	VII	1'-1½"	3'-6½"
422	8	7'-1¼"	VII	1'-7½"	5'-1¼"
423	8	[illegible]	II	2'-5½"	3'-3"
506	12	14'-4"	II	4'-3"	2'-5"
507 to 513	4 Ea.	14'-1" B.E.I. [illegible]	II	4'-1½" B.E.I. 2'-11¾"	2'-5"
514	27	6'-6"	Str		
801		14'-8"			
[illegible]	4	[illegible]			
[illegible]	8	[illegible]			
[illegible]	4	[illegible]			
[illegible]	[illegible]	[illegible]			
[illegible]	26	[illegible]			
[illegible]	54	[illegible]			
[illegible]	46	[illegible]	Str		

Summary

[illegible] Lin Ft #4 Bar @ [illegible] Lbs/Lin Ft = [illegible] Lbs
[illegible] Lin Ft #5 Bar @ 1.043 Lbs/Lin Ft = 345 Lbs
[illegible] Lin Ft #6 Bar @ [illegible] Lbs/Lin Ft = [illegible] Lbs
78 Lin Ft #7 Bar @ [illegible] Lbs/Lin Ft = [illegible] Lbs
[illegible] Lin Ft #[illegible] Bar @ [illegible] Lbs/Lin Ft = [illegible] Lbs
Total = [illegible] Lbs

The first digit or digits (4) of the reinforcing bar designation indicates the bar size. Example: 415 = #4 bar, [illegible] bar

B.E.I. = By Equal Increments

Bar List - Superstructure

MARK	NO. REQ'D	LENGTH	TYPE	DIMENSIONS l	DIMENSIONS m
401	284	4'-9"	Str		
402	568	2'-9"	I	0'-[illegible]"	0'-11"
403	246	40'-0"	Str		
404	76	5'-0"	II	1'-2"	0'-10"
406	41	50'-0"	Str		
502	1138	27'-2"			
503	72	60'-0"			
515	18	49'-0"			
701	48	39'-0"			
702	48	19'-6"	Str		

Summary

[illegible] Lin Ft #4 Bar @ 0.668 Lbs/Lin Ft = 10,141 Lbs
36,118 Lin Ft #5 Bar @ 1.043 Lbs/Lin Ft = 37,671 Lbs
[illegible] Lin Ft #7 Bar @ 2.044 Lbs/Lin Ft = 5,740 Lbs
Total = 53,552 Lbs

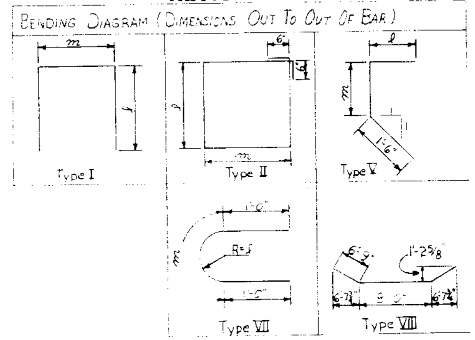
Bar List - [illegible]

MARK	NO. REQ'D	LENGTH	TYPE	DIMENSIONS l	DIMENSIONS m
404	4	[illegible]	II	[illegible]	[illegible]
405	12	4'-[illegible]"	I	[illegible]	2'-4"
407	24	13'-6"	II	4'-8"	[illegible]
408	24	[illegible]	I	[illegible]	2'-2"
40[illegible]	6	[illegible]	Str		
[illegible]	38	[illegible]		[illegible]	[illegible]
4[illegible]	42	[illegible]			
4[illegible]	[illegible]	[illegible]	Str		
4[illegible]	24	4'-[illegible]		[illegible]	[illegible]
[illegible]	12	[illegible]	Str		
504	25	3'-4"			
[illegible]	7	[illegible]			
[illegible]	5	[illegible]			
602	52	[illegible]			
[illegible]	8	[illegible]			
80[illegible]	2	[illegible]			

Summary

[illegible] Lin Ft #4 Bar @ [illegible] Lbs/Lin Ft = 1,28[illegible] Lbs
375 Lin Ft #5 Bar @ 1.043 Lbs/Lin Ft = 394 Lbs
[illegible] Lin Ft #6 Bar @ [illegible] Lbs/Lin Ft = 473 Lbs
[illegible] Lin Ft #8 Bar @ [illegible].400 Lbs/Lin Ft = [illegible]105 Lbs
Total = 4,256 Lbs

Bending Diagram (Dimensions Out To Out Of Bar)



See Book 12 Page 13

Summary of Quantities

ITEM NO.	DESCRIPTION	UNIT	SUPER-STRUCT	ABUT NO. 1	PIER NO. 2	PIER NO. 3	ABUT NO. 4	TOTAL
203	Unclassified Excavation	Cu. Yds.						55
[illegible]	Structure Excavation	Cu. Yds.		[illegible]	[illegible]	[illegible]	300	695
[illegible]	[illegible] Backfill (Class [illegible])	Cu. Yds.		45	30	[illegible]	45	155
[illegible]	[illegible]	[illegible]		82 *+9 ~~70~~	64	116 ~~120~~	186 *+9 ~~72~~	454 ~~444~~
[illegible]	[illegible] ⊘	Cu. Yds.		154 ~~350~~			195 ~~430~~	692 ~~840~~
[illegible]	[illegible] ⊘	[illegible]		352 ~~450~~			350 ~~640~~	2990
[illegible]	[illegible]	[illegible]	[illegible]					196,984
[illegible]	[illegible]	[illegible]	[illegible]					23,052
[illegible]	[illegible]	[illegible]						2
[illegible]	[illegible]	[illegible]						990
[illegible]	[illegible] Class A	Cu. Yds.		[illegible]	[illegible]	[illegible]	[illegible]	175
[illegible]	[illegible]	Cu. Yds.	[illegible]					202
[illegible]	Reinforcing Steel	Lbs.	[illegible]	4,256	[illegible]	10,464	4,25[illegible]	83,320
(1) [illegible]	3" Electrical Conduit	Lin. Ft.	288					288

(1) Non Federal Aid Reimbursable by Mountain States T&T. See Note Dwg. No. B-6

* For welds

⊘ No pay item. Force Account under C.O. No 22633. Included in Riprap Tabulations

INITIAL	DATE	
DESIGNED BY R.W.G.	8-62	CHECKED BY R.W.G. 8-62
CHECKED BY D.L.R.	8-62	QUANTITIES BY D.L.R. 8-62
DETAILED BY C.L.B.	8-63	CHECKED BY R.W.G. 8-62

DIVISION OF HIGHWAYS

Summary of Quantities, Bar List, Bending Diagram

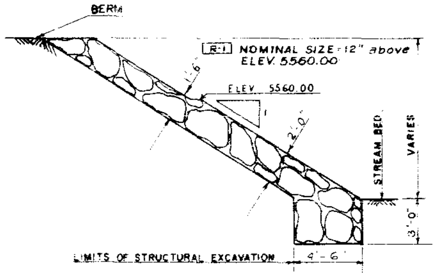
Approved
Bridge Engineer
Date

Designer: R.W.G. Detailer: B.D.
Structure Numbers: F-6-M
DWG. No. B 2 of 11

FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	I-70-1(27)105	53	

REVISIONS

R-1 Rev. 3-13-70 W.E.M.

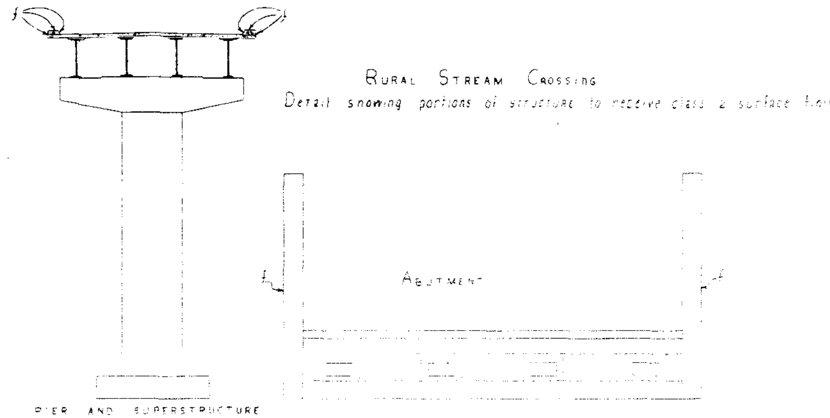


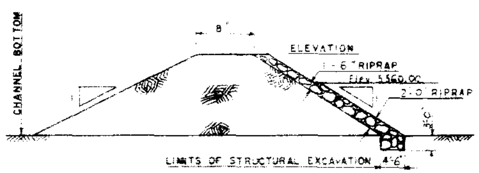
DETAIL OF RIPRAP WITH TOE

NOTES:

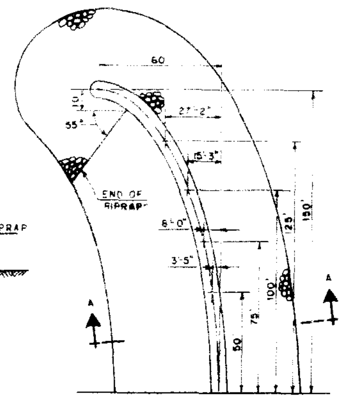
TRANSITION ENDS OF RIPRAP MAY BE MODIFIED BY THE ENGINEER TO FIT CONDITIONS ENCOUNTERED IN THE FIELD.

R-1 NOMINAL SIZE 18" below ELEV. 5560.00



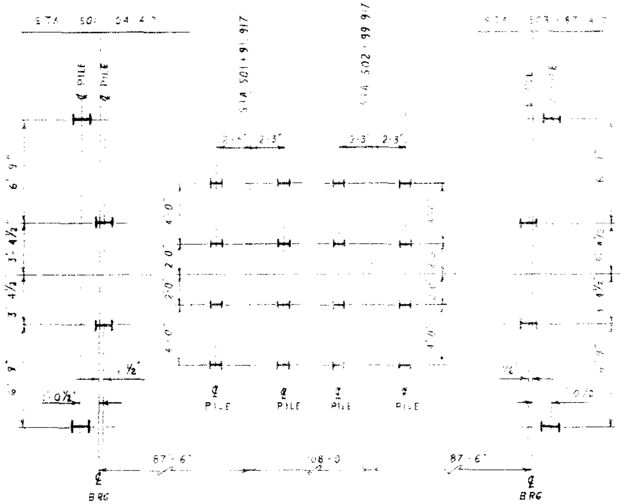


SECTION A - A



PLAN

DETAIL OF SPUR DIKE



PILING LAYOUT

Initials	Date
DSP	10-67
RWS	8-63
L.F.	8-63

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO

SPUR DIKE DETAILS
SURFACE FINISH
PILE LAYOUT

Across COLORADO RIVER
Sta. 500 to 503+88.333
Near NEW CASTLE Sec. 2-32 T. 5-6S R. 90-91 W

Designed by F.W.G. | Approved by
Made by B.U.D. | Bridge Engineer
Checked by | Date: 19

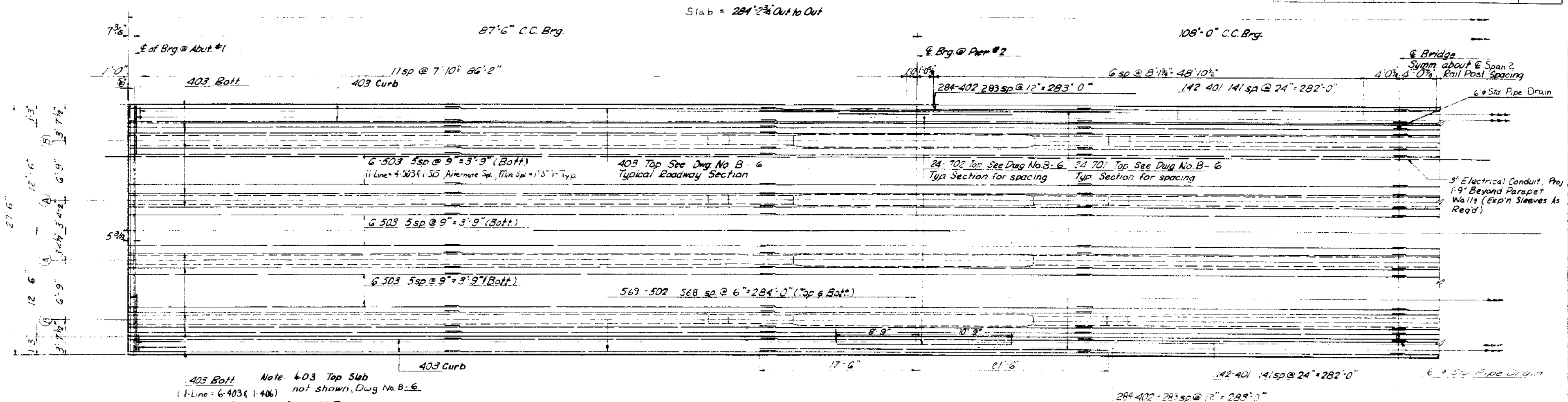
STRUCTURE NO. F-6-M

DWG. No. B 3 OF 11

REVISIONS

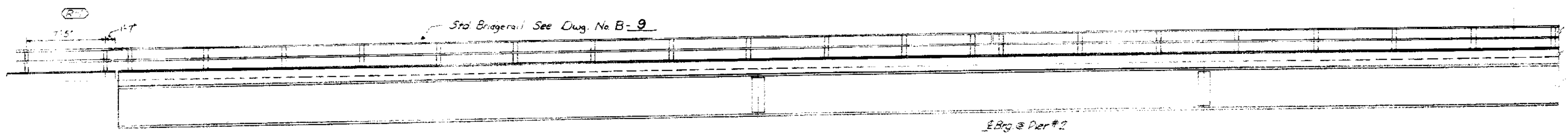
R-1	6-12-70	Revised Wingwall Bridgerail Dimen.	TCF

FEDERAL ROAD REGION No.	DIVISION	PROJECT No.	SHEET No.
9	COLORADO	I-70-1(27)105	54



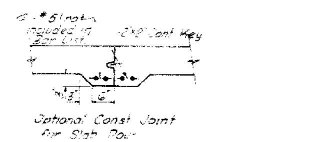
HALF DECK PLAN (SYMM. ABOUT ℄ SPAN 2)

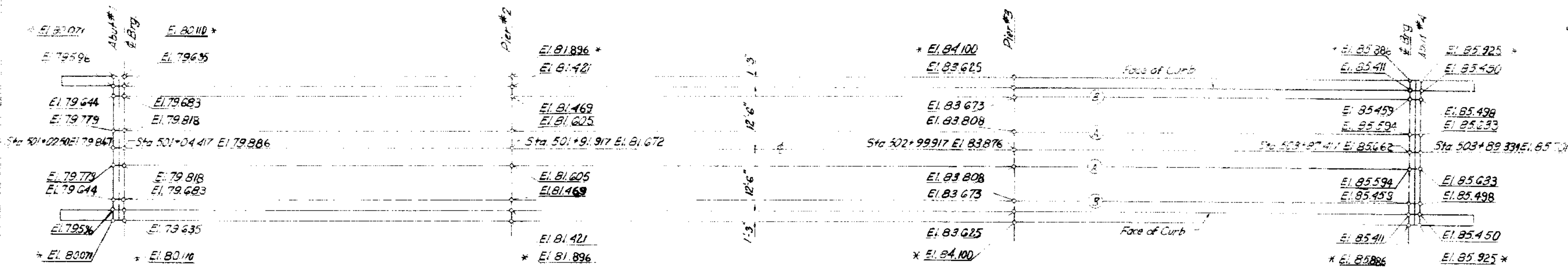
3/16" = 1'-0"



HALF RAIL ELEVATION

3/16" = 1'-0"





FINISHED ROADWAY ELEVATIONS

(Except Those Marked * Which Are Top Of Curb.)

All scales shown are Original Scale

DWG. No. B-4 OF 11 STRUCTURE NO. F-6-M

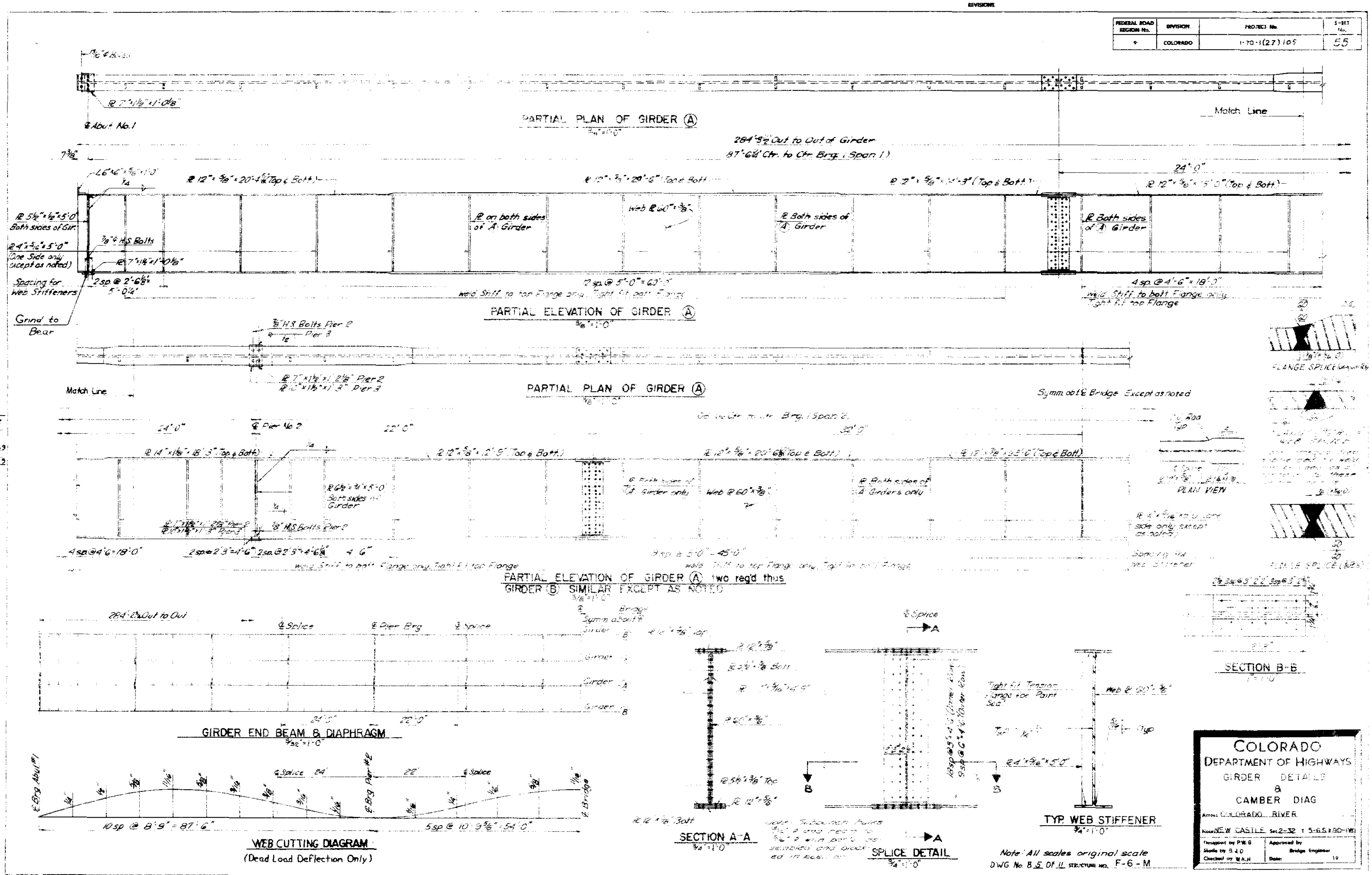
COLORADO DEPARTMENT OF HIGHWAYS

DECK PLAN & ELEVATION

Across COLORADO RIVER

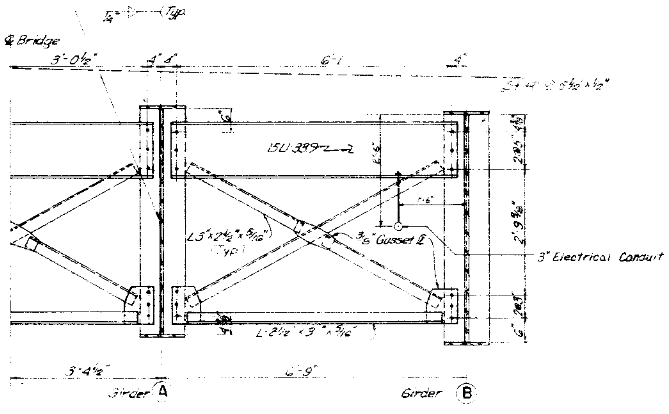
Near NEW CASTLE Sec 2-32 T. 5S R. 90 W

Designed by P.W.G.
Made by B.J.D.
Checked by W.A.H.
Approved by Bridge Engineer
Date: 19


REVISIONS
FEDERAL ROAD REGION No. 9
DIVISION COLORADO
PROJECT No. I-70-1(27)105
SHEET No. 55
PARTIAL PLAN OF GIRDER (A)
℄ Abut. No. 1
284'-8½" Out to Out of Girder
87'-6¼" Ctr. to Ctr. Brg. (Span 1)
24'-0"
Match Line
⅞" ⌀ H.S. Bolts
Spacing for Web Stiffeners
Grind to Bear
12 sp. @ 5'-0" = 60'-0"
4 sp. @ 4'-6" = 18'-0"
Weld Stiff. to top Flange only, Tight fit bott. Flange
Weld Stiff. to bott. Flange only, Tight fit top Flange
PARTIAL ELEVATION OF GIRDER (A)
PARTIAL PLAN OF GIRDER (A)
Symm. abt. ℄ Bridge Except as noted
℄ Pier No. 2
Web ℞ 60" x ⅜"
PARTIAL ELEVATION OF GIRDER (A) two req'd thus
GIRDER (B) SIMILAR EXCEPT AS NOTED
FLANGE SPLICE
GIRDER END BEAM & DIAPHRAGM
284'-2¾" Out to Out
℄ Splice
℄ Pier Brg.
Girder B
Girder A
SECTION A-A
SPLICE DETAIL
SECTION B-B
TYP. WEB STIFFENER
WEB CUTTING DIAGRAM
(Dead Load Deflection Only)
10 sp. @ 8'-9" = 87'-6"
5 sp. @ 10'-9⅝" = 54'-0"
℄ Brg. Abut. #1
℄ Brg. Pier #2
℄ Bridge
Note: All scales original scale
DWG. No. 8.5 OF 11 STRUCTURE NO. F-6-M
COLORADO
DEPARTMENT OF HIGHWAYS
GIRDER DETAILS
&
CAMBER DIAG.
COLORADO RIVER
NEW CASTLE
Designed by P.W.G.
Made by B.J.O.
Checked by W.A.H.
Approved by
Bridge Engineer

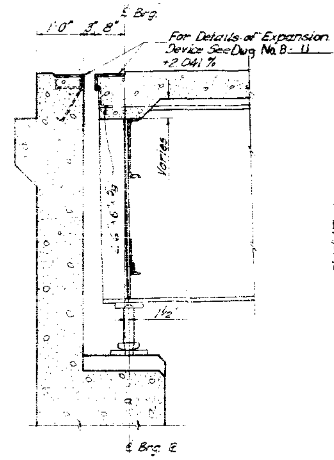
REVISIONS

FEDERAL ROAD REGION No.	DIVISION	PROJECT No.	SHEET No.
9	COLORADO	I-70-1(27)105	56



SECTION AT END BEAMS (ABUT.)

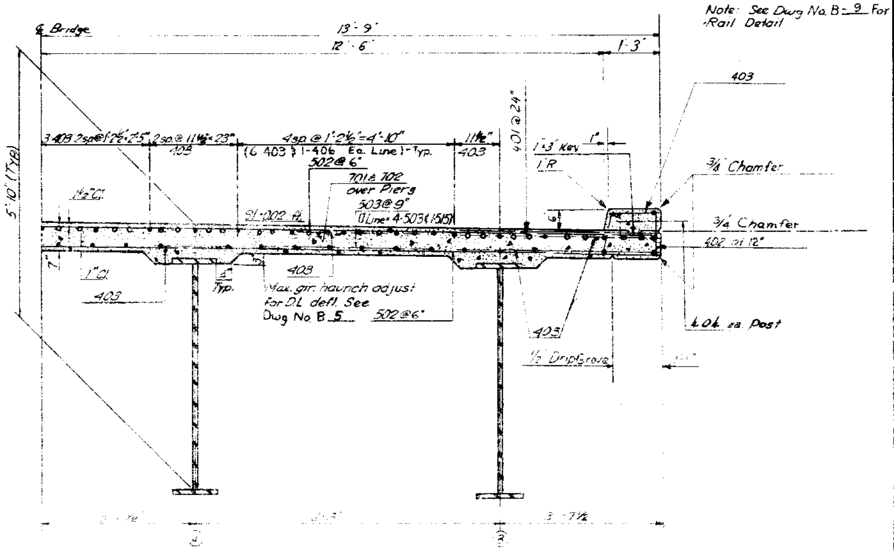
¾" = 1'-0"



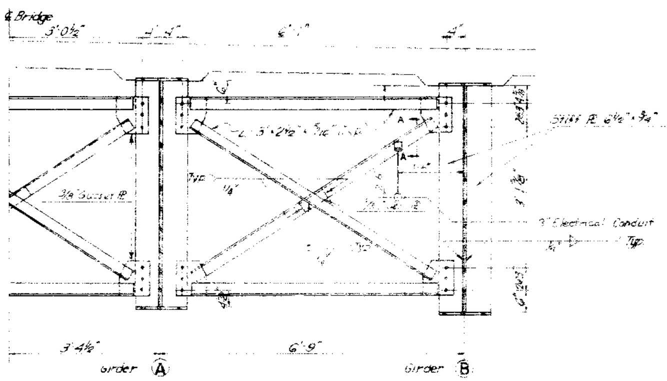
SECTION AT ABUTMENT ①

¾" = 1'-0"

Note: See Dwg No. B-9 For Rail Detail

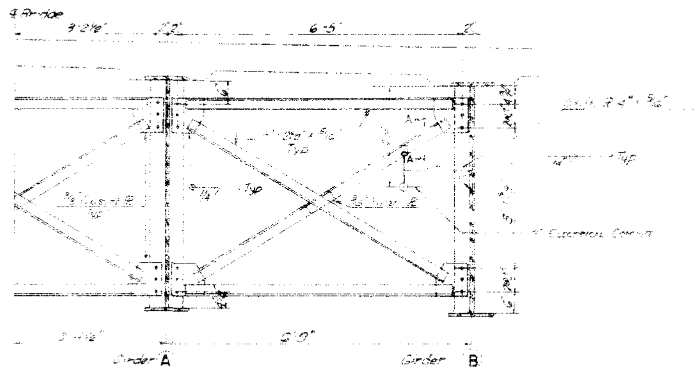


TYPICAL SECTION



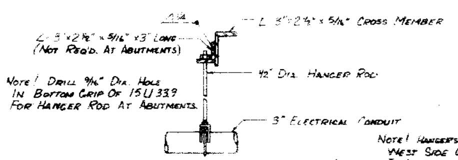
SECTION AT PIER CROSS FRAME

¾" = 1'-0"



SECTION AT INTERMEDIATE CROSS FRAME

¾" = 1'-0"



Note: Drill 9/16" Dia. Hole In Bottom Grip Of 15U 339 For Hanger Rod At Abutments.

SECTION A-A

Note: Hangers Spaced At 20'-0" ± (14 Req'd.) West Side Only. All Work Necessary To Accomplish The Above Shall Be Included In The Bid Price For Item 613, 3" Electrical Conduit. The Contractor Shall Notify Mtn. States Tel. & Tel. Co. And Arrange Inspection Of Conduit Placement. Work To Be Done By The Contractor (Non-Fed. Aid). M.S.T.&T. Co. To Reimburse The Highway Dept. For This Work.

Note: All scales shown are Original Scale

DWG No B 6 OF 11 STRUCTURE NO. F-6-M

PWG
BJD
RWG 8-69
D.R. 8-69

COLORADO
DEPARTMENT OF HIGHWAYS

MISCELLANEOUS DETAILS

Across COLORADO RIVER

Near NEW CASTLE Sec. 2-32 T. 5-6S R. 90-1W

Designed by P.W.G.	Approved by Bridge Engineer
Made by B.J.D.	
Checked by W.A.H.	Date: 19

FED. ROAD DIV. NO.	STATE	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	S 0143(2)	1	

Rev. - Index of Sheets - 2-3-49 CJW.

143.62

COLORADO
STATE HIGHWAY DEPARTMENT

PLAN AND PROFILE OF PROPOSED
FEDERAL AID SECONDARY PROJECT NO. S 0143 (2)
STATE HIGHWAY NO. 340
MESA COUNTY

SCALES OF ORIGINAL TRACINGS
ON PLAN, 1 IN. - 100 FT.
ON PROFILE: 1 IN. - 100 FT. HORIZONTAL; 1 IN. - 10 FT. VERTICAL
GRADE LINE ON PROFILE IS SHOWN AS GRADE OF FINISHED ROAD
GROSS LENGTH OF PROJECT / NET LENGTH OF PROJECT 5490 FEET = 1.039 MILES

INDEX OF SHEETS

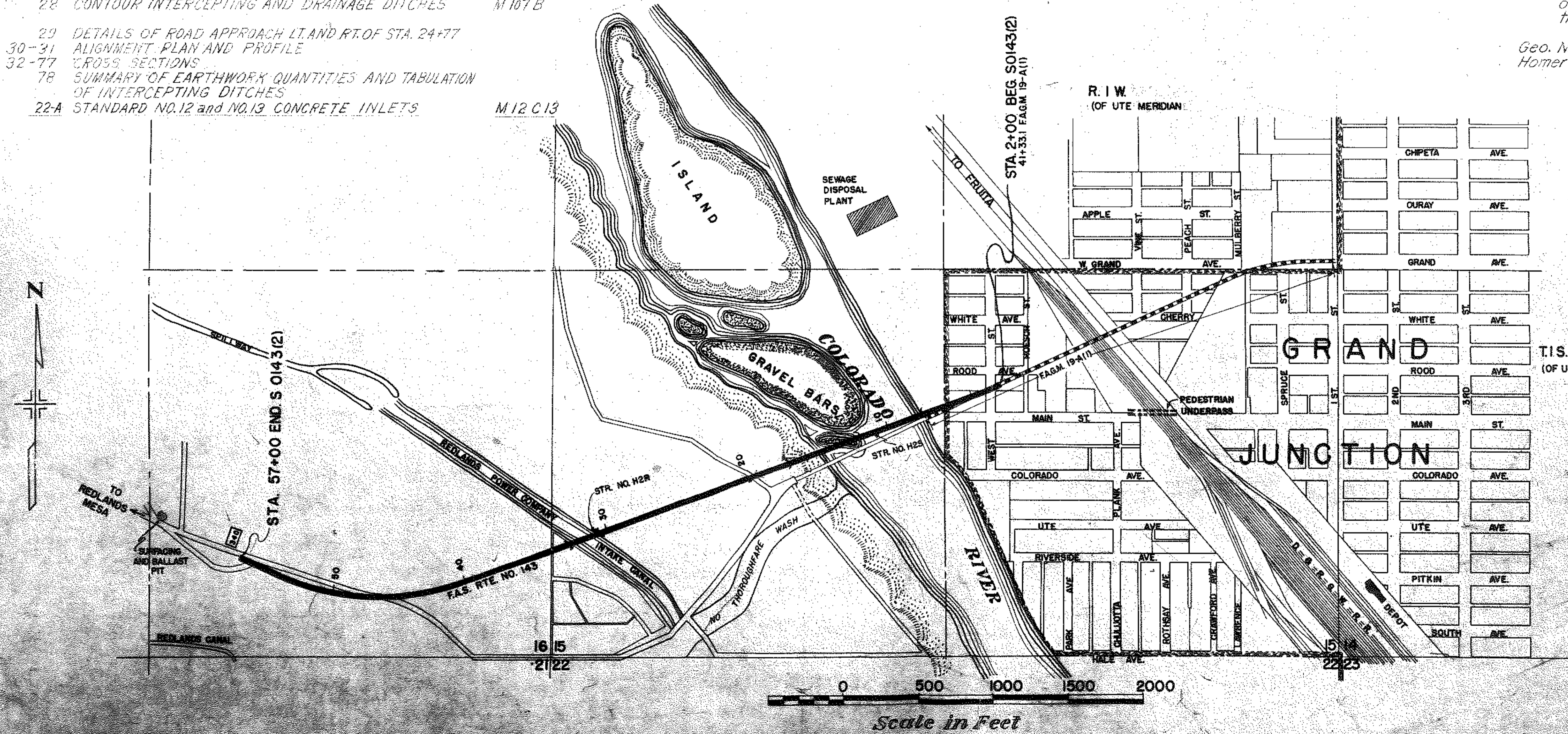
CONVENTIONAL SIGNS

CENTER LINE OF SURVEY
RIGHT OF WAY LINE
SECTION LINE
ONE QUARTER SECTION LINE
CITY LIMITS
BARBED WIRE FENCE
COMBINATION WIRE FENCE
BOARD FENCE
WATER PIPE LINE
SEWER PIPE LINE
TELEPH. & TELEG. LINE
POWER LINE
RAILROADS

NOTE:

It is recommended that bidders on this Project go over the plan details with one of the following field representatives of this Department.

Geo. N. Miles - District Engineer - Grand Junction, Colo.
Homer Gray - Construction Engineer - Grand Junction, Colo.



RECOMMENDED FOR APPROVAL
Jack Bell
ASSISTANT ENGINEER — DATE 12-29-48

APPROVED
Mark U. Watrous
STATE HIGHWAY ENGINEER — DATE 12-30-48

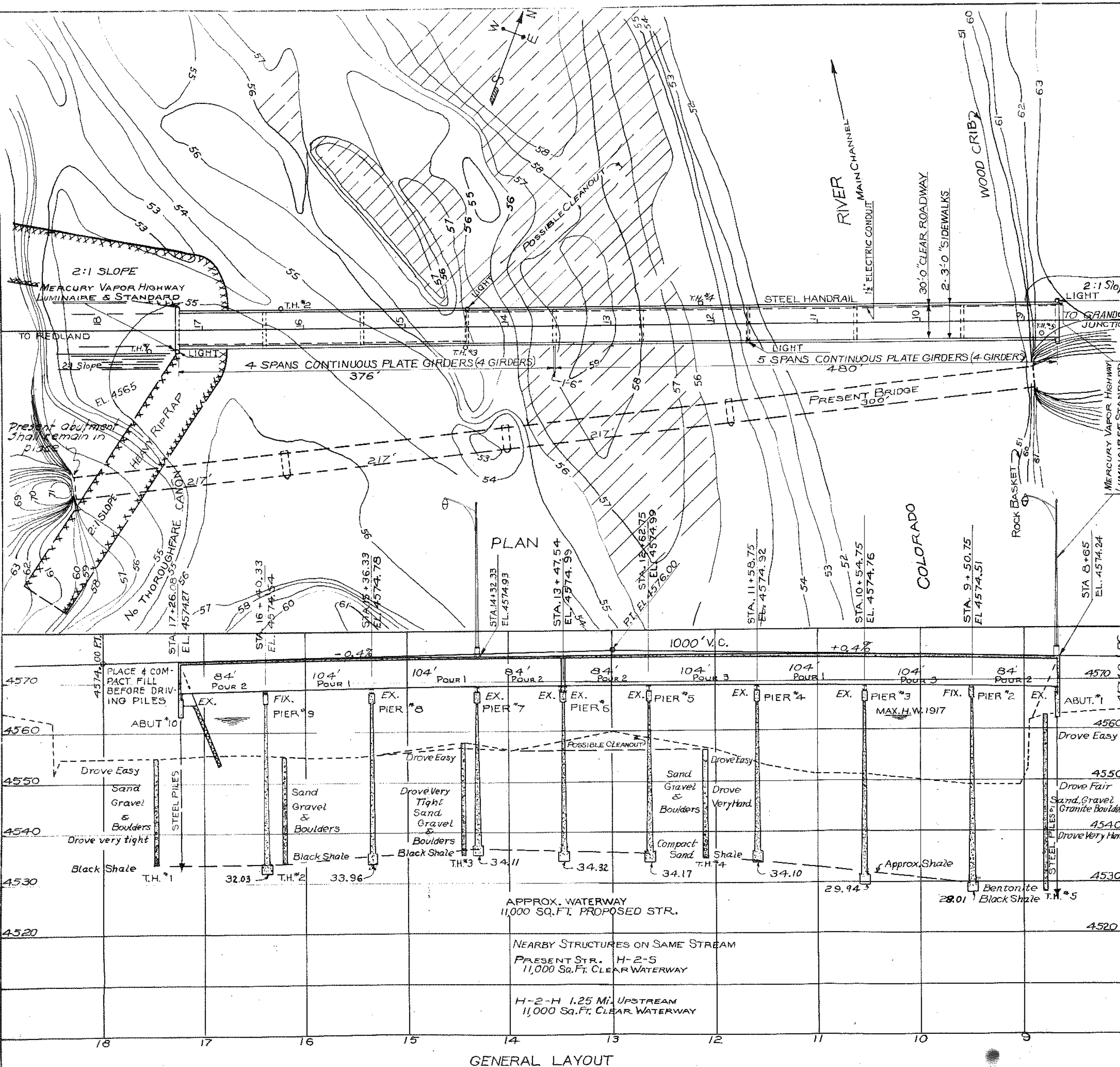
RECOMMENDED FOR APPROVAL — DATE
DISTRICT ENGINEER
PUBLIC ROADS ADMINISTRATION
FEDERAL WORKS AGENCY

APPROVED — DATE
DIVISION ENGINEER
PUBLIC ROADS ADMINISTRATION
FEDERAL WORKS AGENCY

REVISIONS

REV. 4-30-48 E.F.W. Raised Grade 2'-0"
Rev. Detail of Riprap 2-3-49 C.J.W.
Rev. Footing Elev. Pier 5, 4-15-49 B.D.I.
Rev. 6-15-49 A.F.H. Delete Sheet Metal
Rev. 7-20-49 A.F.H. Raised Handrail

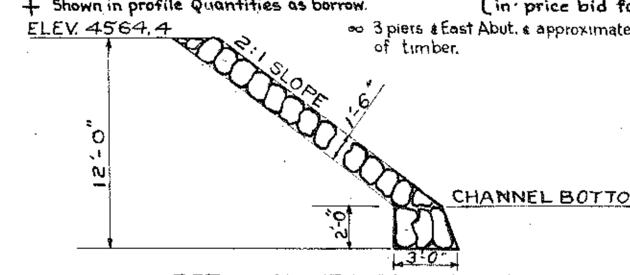
FED. ROAD DIST. NO.	STATE	PROJ. Nº	SHEET NO.	TOTAL SHEETS
3	COLO.	S 0143 (2)	7	



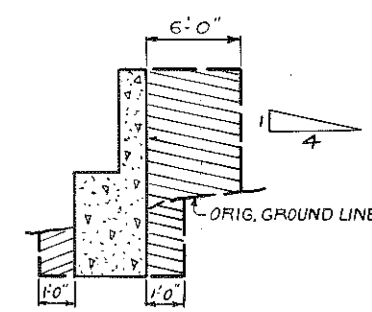
SUMMARY OF QUANTITIES

ITEM Nº		UNIT	SUPERSTRUCTURE	ABUT. Nº 1	PIER Nº 2	PIER Nº 3	PIER Nº 4	PIER Nº 5	PIER Nº 6	PIER Nº 7	PIER Nº 8	PIER Nº 9	ABUT. Nº 10	TOTAL
13c	UNCLASSIFIED EXCAVATION	CU.YD.												+
14a	DRY ROCK EXCAVATION (STR.)	CU.YD.						5						5
14b	DRY COMMON EXCAVATION (STR.)	CU.YD.		9				83	70	53	26	38	98	377
14c	WET ROCK EXCAVATION (STR.)	CU.YD.			20	23	9	20	15	23	44	24		178
14d▷	WET COMMON EXCAVATION (STR.)	CU.YD.			395	374	350	320	312	300	333	380	49	2813
16a	STRUCTURE BACKFILL CLASS I	CU.YD.		156	300	271	260	350	277	285	273	319	186	2677
16d	MECHANICAL TAMPING	HR.		16	30	27	26	35	28	29	27	32	19	269
42a	UNTREATED BRIDGE TIMBER	M.FT. B.M.		0.12									0.12	0.24
46a	CLASS "A" CONCRETE	CU.YD.	797	33	172	154	133	133	136	133	133	148	33	2005
47	REINFORCING STEEL	LB.	158,700	2600	10240	6470	5630	5630	5970	5630	5630	7700	2800	216,800
48	STRUCTURAL STEEL	LB.	1,093,470	645	845	845	845	845	845	845	845	845	645	1,102,520
61a	STEEL PILING (12" CBP @ 53#)	Lin.Ft.		365									311	676
67b	HEAVY RIPRAP	CU.YD.											443	443
80c	SHEET COPPER - 32 OZ.	LB.	18											18
89a	DRAIN PIPE (CONCRETE FLOOR) 4" ø × 2'-0"	EACH	82											82
□90	1½" ELECTRICAL CONDUIT & JCN. BXs.	Lin.Ft.	926	4									4	934
98a	LIGHT STANDARD COMPLETE	EACH	2	1									1	4
98c	HIGHWAY LUMINAIRE	EACH	2	1									1	4
◆	TELEPHONE CABLE SUPPORTS	EACH	8											8
*	½" EXP'N. JT. MATL	SQ.FT.	220											220
✱	3" ø × 1'-0" IRON PIPE	EA.		2									2	4
◆	⅝" ø × 14" THIMBLE EYE BOLTS	EA.		4									4	8

▷ ASSUMED WET LINE 4554.0
ø INCLUDES 70,320 LBS. FOR HANDRAIL
* INCLUDE IN PRICE BID FOR CLASS "A" CONCRETE
□ Max. Spacing of outlet boxes shall be no more than 150 ft. 1-Exp'n. Coupling Req'd.
◆ Furnished by Grand Junction Telephone office. {Installation of portions of Telephone Cable Support to be included in price bid for CLASS "A" CONCRETE. See Note on Sheet Nº 10.
+ Shown in profile Quantities as borrow.
∞ 3 piers & East Abut. & approximately 560,300# of structural steel & 129,000 bd ft. of timber.



DETAIL OF HEAVY RIPRAP



STRUCTURE BACKFILL DIAGRAM

REFERENCE DRAWINGS

SHEET Nº 8 DETAILS OF SUPERSTRUCTURE
SHEET Nº 9 " " "
SHEET Nº 10 DETAILS OF SUPERSTR. EXP'N DEVICES & BEARINGS
SHEET Nº 11 DETAILS OF PLATE GIRDERS
SHEET Nº 12 DETAILS OF ABUTS. Nº 1 & Nº 10 & BAR LISTS.
SHEET Nº 13 DETAILS OF PIERS Nº 2 & Nº 3
SHEET Nº 14 DETAILS OF PIERS Nº 4, 5, 6, 7, 8, & 9

LOADING DATA.
LIVE LOAD A. A. S. H. O. H-20-44
DEAD LOAD ASSUMES 15 LBS. PER SQ. FT. ADDITIONAL WEARING SURFACE WHICH INCLUDES THE ½ INCH CONCRETE MONOLITHIC WEARING SURFACE SHOWN.

DESIGNING DATA.
fc = 1000 lbs. per sq. in.
Structural Steel fs = 18000 lbs. per sq. in.
Reinforcing Steel fs = 20,000 lbs. per sq. in.
n = 10

GENERAL NOTES

ALL WORK SHALL BE DONE ACCORDING TO THE STANDARD SPECIFICATIONS OF THE COLORADO STATE HIGHWAY DEPARTMENT.

ALL CONCRETE SHALL BE CLASS "A."

FORMS FOR CONCRETE SURFACES EXPOSED IN THE FINISHED WORK SHALL BE CONSTRUCTED OF SHIPLAP OR TONGUE AND GROOVE LUMBER S3S UNLESS FACED WITH PANEL BOARD.

CONCRETE GIRDERS, FLOOR SLABS AND CURB SHALL BE POURED MONOLITHICALLY.

FOOTINGS IN ROCK SHALL BE POURED OUT TO THE ROCK AND NOT FORMED.

ALL REINFORCING BARS SHALL BE INTERMEDIATE GRADE.

ALL REINFORCING BARS SHALL BE DEFORMED AND TAGGED WITH THE STATION NUMBER AND LETTER DESIGNATION. MAIN BARS SHALL NOT BE SPLICED.

SOUNDINGS AND DEPTH OF FOOTINGS SHOWN ARE ACCORDING TO THE BEST AVAILABLE DATA. IF ESSENTIALLY DIFFERENT CONDITIONS ARE ENCOUNTERED THE BRIDGE ENGINEER WILL INSPECT AND DETERMINE IF REDESIGN IS NECESSARY.

ALL RIVETS TO BE ⅞" DIA. ALL RIVETS TO BE POWER DRIVEN.

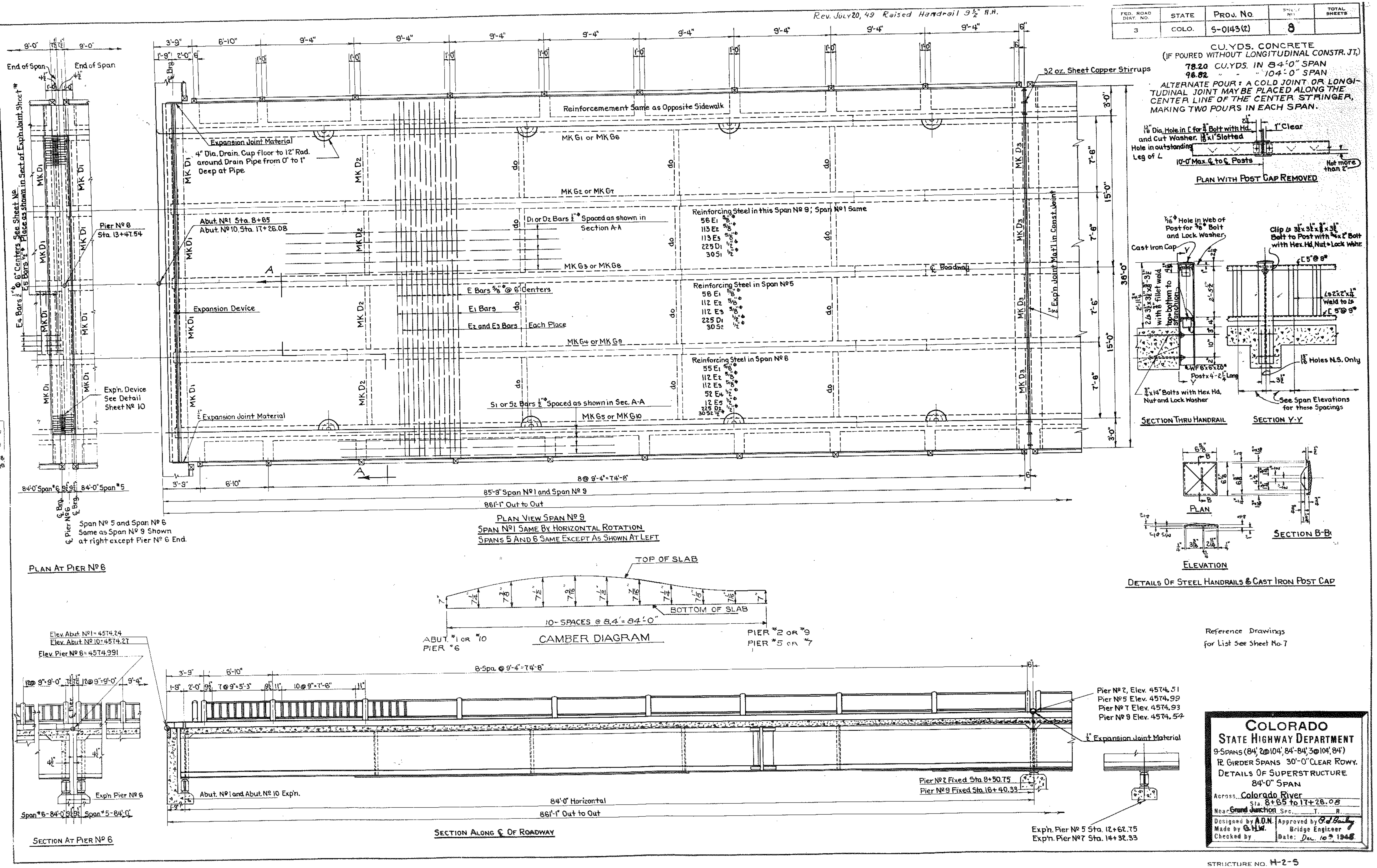
ALL CONCRETE SURFACES EXPOSED TO VIEW SHALL BE GIVIEN CLASS I SURFACE FINISH, EXCEPT UNDERSIDE OF FLOOR SLABS, AND ABUTMENT FACES BELOW STRINGERS.

ALL STRUCTURAL STEEL TO BE GIVEN ONE SHOP COAT OF ZINC CHROMATE & TWO FIELD COATS OF ALUMINUM PAINT.

COLORADO
STATE HIGHWAY DEPARTMENT
9-SPANS (84', 2@104', 84', 84', 3@104' & 84') PL GIRDER SPANS
30'-0" CLEAR ROADWAY
GENERAL LAYOUT AND SUMMARY OF QUANTITIES
Across COLORADO RIVER
Sta. 8+65.00 to 17+26.08
Near GRAND JUNCTION Sec. 15 T. 1 S. R. 100 W.

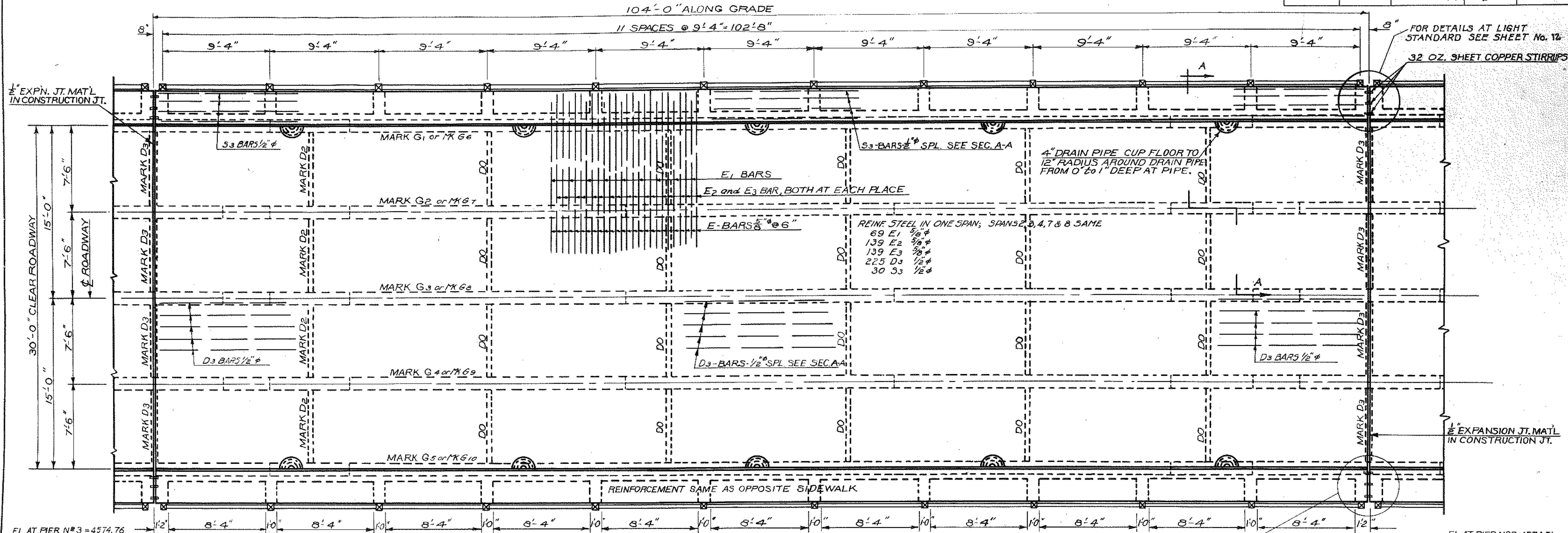
Designed by ADN	Approved by C. S. Bailey, Bridge Engineer
Made by EFW	
Checked by	Date: Dec. 10th, 1948

STRUCTURE NO. H-2-S


Rev. July 20, 49 Raised Handrail 9 1/2" R.H.
FED. ROAD DIST. NO. 3 | STATE COLO. | PROJ. NO. S-0143(2) | SHEET NO. 8 | TOTAL SHEETS
CU. YDS. CONCRETE
(IF POURED WITHOUT LONGITUDINAL CONSTR. JT.)
78.20 CU. YDS. IN 84'-0" SPAN
96.82 " " " 104'-0" SPAN
ALTERNATE POUR: A COLD JOINT OR LONGITUDINAL JOINT MAY BE PLACED ALONG THE CENTER LINE OF THE CENTER STRINGER, MAKING TWO POURS IN EACH SPAN.
PLAN WITH POST CAP REMOVED
SECTION THRU HANDRAIL
SECTION Y-Y
PLAN
SECTION B-B
ELEVATION
DETAILS OF STEEL HANDRAILS & CAST IRON POST CAP
32 oz. Sheet Copper Stirrups
Reinforcement Same as Opposite Sidewalk
Expansion Joint Material
4" Dia. Drain. Cup floor to 12" Rad. around Drain Pipe from 0" to 1" Deep at Pipe
Abut. Nº 1 Sta. 8+65
Abut. Nº 10 Sta. 17+26.08
Reinforcing Steel in this Span Nº 9; Span Nº 1 Same
Reinforcing Steel in Span Nº 5
Reinforcing Steel in Span Nº 6
Expansion Device
1/2" Exp'n Joint Mat'l in Const Joint
PLAN VIEW SPAN Nº 9
SPAN Nº 1 SAME BY HORIZONTAL ROTATION
SPANS 5 AND 6 SAME EXCEPT AS SHOWN AT LEFT
85'-9" Span Nº 1 and Span Nº 9
861'-1" Out to Out
PLAN AT PIER Nº 6
Span Nº 5 and Span Nº 6 Same as Span Nº 9 Shown at right except Pier Nº 6 End.
TOP OF SLAB
BOTTOM OF SLAB
10-SPACES @ 8.4' = 84'-0"
CAMBER DIAGRAM
ABUT. #1 OR #10 PIER #6
PIER #2 OR #9 PIER #5 OR #7
Reference Drawings for List See Sheet No. 7
SECTION AT PIER Nº 6
SECTION ALONG ℄ OF ROADWAY
84'-0" Horizontal
861'-1" Out to Out
Pier Nº 2 Fixed Sta. 8+50.75
Pier Nº 9 Fixed Sta. 16+40.33
Exp'n. Pier Nº 5 Sta. 12+62.75
Exp'n. Pier Nº 7 Sta. 14+32.33
COLORADO
STATE HIGHWAY DEPARTMENT
9-SPANS (84', 2@104', 84'-84', 3@104', 84')
PL GIRDER SPANS 30'-0" CLEAR ROWY.
DETAILS OF SUPERSTRUCTURE
84'-0" SPAN
Across Colorado River
Sta. 8+65 to 17+26.08
Near Grand Junction
Designed by A.O.N.
Made by G.H.W.
Approved by Bridge Engineer
Date: Dec. 10th 1948
STRUCTURE NO. H-2-5

REVISIONS Slab thickness reduced ...

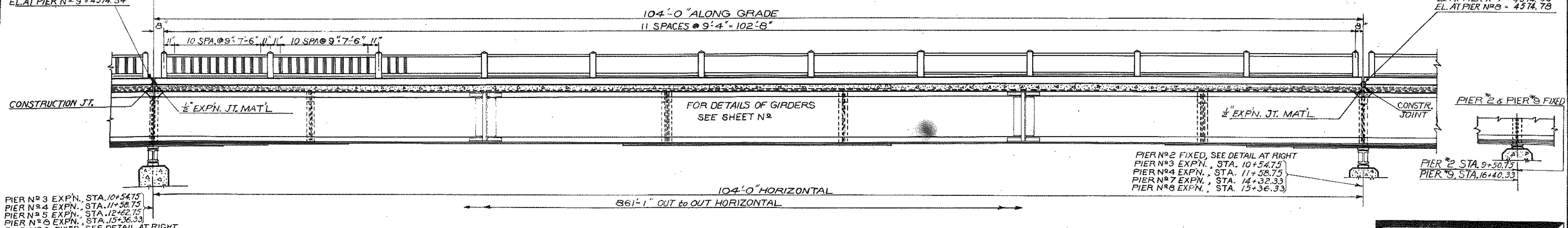
FED. ROAD DIST. NO.	STATE	PROJ. No	SHEET NO.	TOTAL SHEETS
3	COLO.	S-0143 (2)	9	



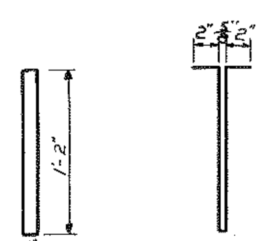
PLAN VIEW, TYPICAL FOR SPANS No 2,3,4,7 & 8

EL. AT PIER No 3 = 4574.76
EL. AT PIER No 4 = 4574.92
EL. AT PIER No 5 = 4574.99
EL. AT PIER No 8 = 4574.78
EL. AT PIER No 9 = 4574.54

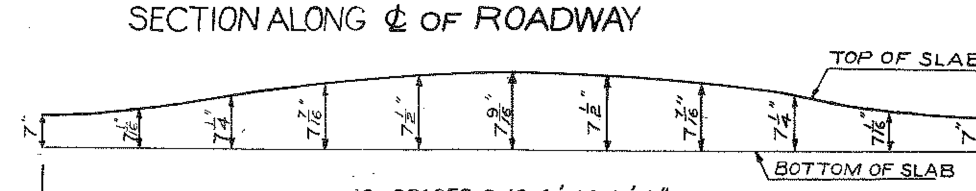
EL. AT PIER No 2 = 4574.51
EL. AT PIER No 3 = 4574.76
EL. AT PIER No 4 = 4574.92
EL. AT PIER No 7 = 4574.93
EL. AT PIER No 8 = 4574.78



SECTION ALONG ℄ OF ROADWAY



DETAIL OF 32 OZ. SHEET COPPER STIRRUP



CAMBER DIAGRAM

CU. YDS. CONCRETE
(IF POURED WITHOUT LONGITUDINAL CONSTRUCTION JOINT)
78.20 CU. YD. IN 84'-0" SPAN
96.82 " " " 104'-0" SPAN

ALTERNATE POUR: A COLD JOINT OR LONGITUDINAL JOINT MAY BE PLACED ALONG THE CENTER LINE OF THE CENTER STRINGER, MAKING TWO POURS IN EACH SPAN.

REFERENCE DRAWINGS FOR SHEET Nos. SEE SHT. No 7

COLORADO
STATE HIGHWAY DEPARTMENT
9 SPANS (84', 2@104, 84 84, 3@104, 84)
PL GIRDER SPANS
30'-0" CLEAR ROADWAY
DETAILS OF SUPERSTRUCTURE,
104'-0" SPAN
Across COLORADO RIVER
Sta. 8+65 to 17+26.08
Near GRAND JCT. Sec. 15 T. 1 S. R. 100 W

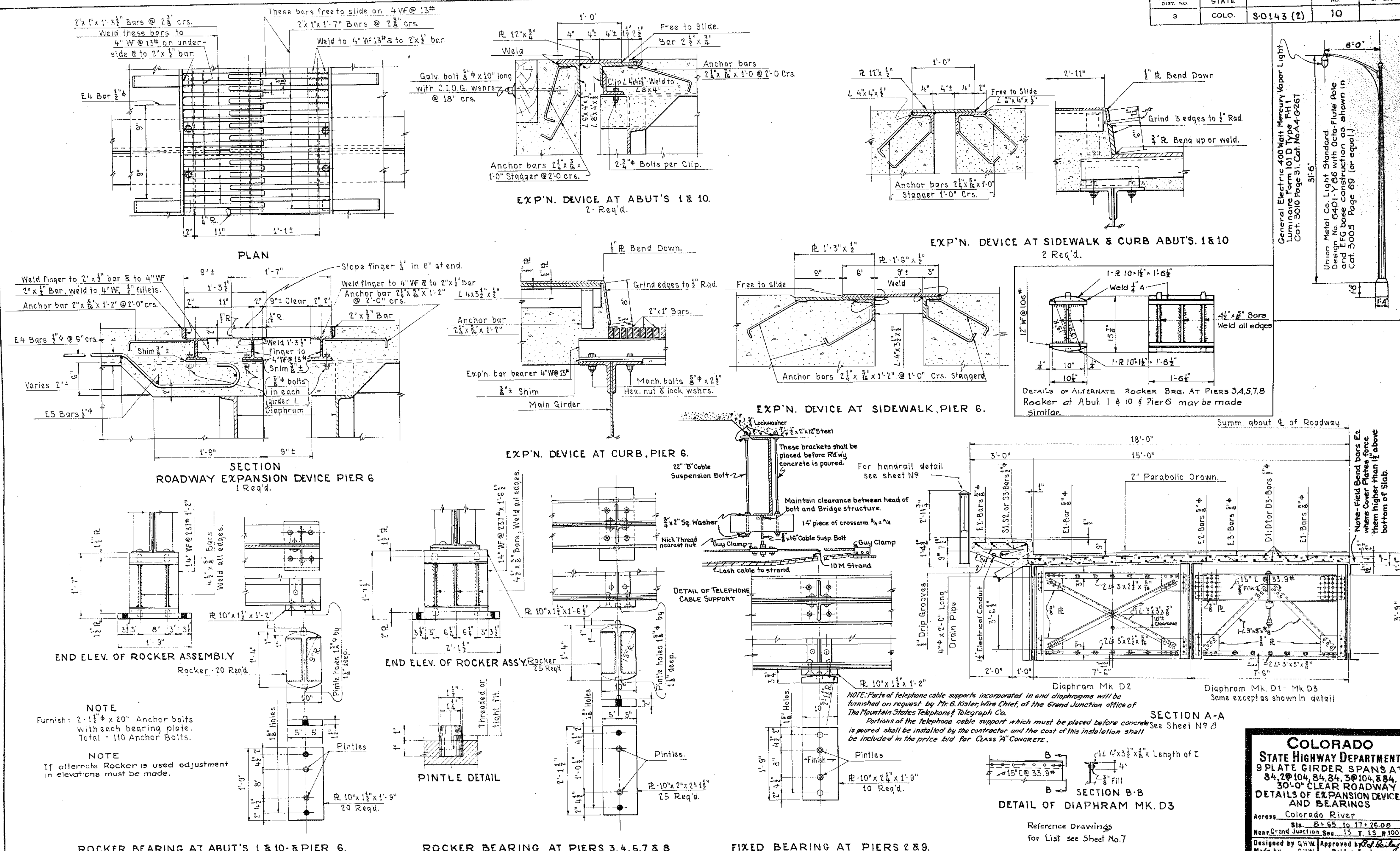
Designed by ADN
Made by
Checked by

Approved by G. L. Bailey
Bridge Engineer
Date: Dec. 10 1948

STRUCTURE No. H-2-S

REVISIONS Raised Handrail 9½" 7-20-49 R.H. Reduced Slab Thickness E.F.S. 7-20-49

FED. ROAD DIST. NO.	STATE		SHEET NO.	TOTAL SHEETS
3	COLO.	S-0143 (2)	10	



SECTION A-A
See Sheet No 8

NOTE
Furnish: 2-1⅛"Φ x 20" Anchor bolts with each bearing plate. Total = 110 Anchor Bolts.

NOTE
If alternate Rocker is used adjustment in elevations must be made.

NOTE: Parts of telephone cable supports incorporated in end diaphragms will be furnished on request by Mr. G. Kisler, Wire Chief, of the Grand Junction office of The Mountain States Telephone & Telegraph Co.

Portions of the telephone cable support which must be placed before concrete is poured shall be installed by the contractor and the cost of this installation shall be included in the price bid for Class "A" Concrete.

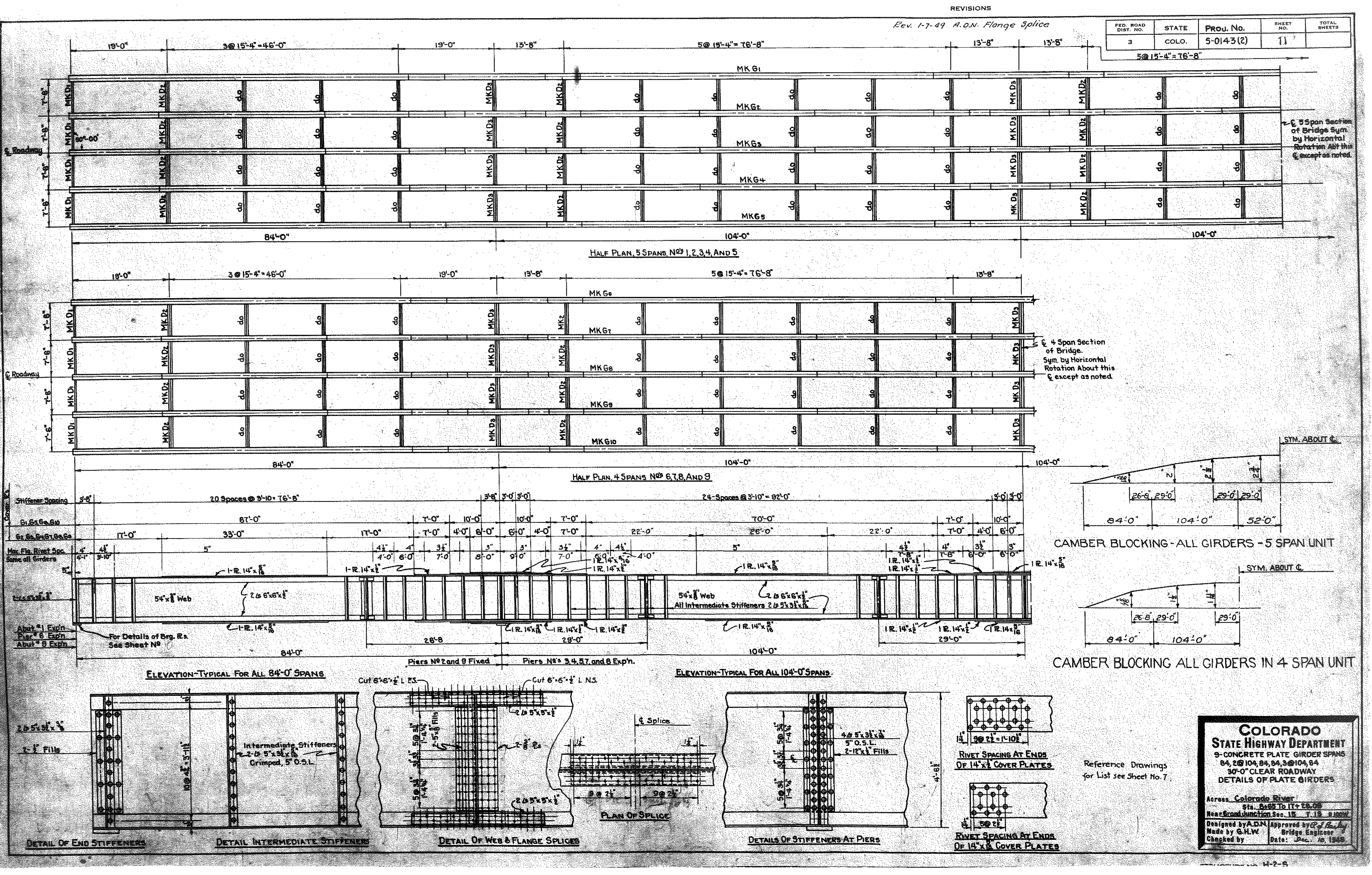
Reference Drawings for List see Sheet No. 7

COLORADO
STATE HIGHWAY DEPARTMENT
9 PLATE GIRDER SPANS AT 84, 2@104, 84, 84, 3@104, 84 & 84.
30'-0" CLEAR ROADWAY
DETAILS OF EXPANSION DEVICES AND BEARINGS

Across Colorado River
Sta. 8+65 to 17+26.08
Near Grand Junction Sec. 15 T. 1S R. 100W

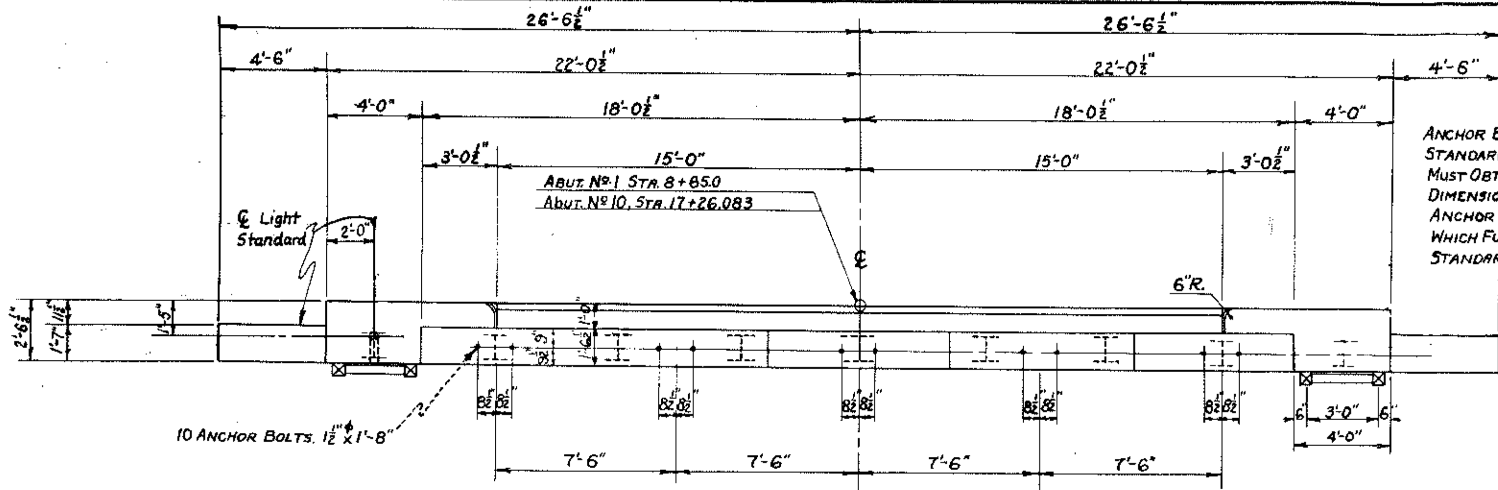
Designed by G.H.W.	Approved by R.L. Bailey
Made by G.H.W.	Bridge Engineer
Checked by	Date: Dec. 10, 1948.

H-2-8


REVISIONS
Rev. 1-7-49 A.O.N. Flange Splice
FED. ROAD DIST. NO. 3
STATE COLO.
PROJ. No. S-0143(2)
SHEET NO. 11
TOTAL SHEETS
HALF PLAN, 5 SPANS, NOS 1, 2, 3, 4, AND 5
C 5 Span Section of Bridge Sym. by Horizontal Rotation Abt this C except as noted.
HALF PLAN, 4 SPANS NOS 6, 7, 8, AND 9
C 4 Span Section of Bridge. Sym. by Horizontal Rotation About this C except as noted.
C Roadway
SYM. ABOUT C
CAMBER BLOCKING - ALL GIRDERS - 5 SPAN UNIT
CAMBER BLOCKING ALL GIRDERS IN 4 SPAN UNIT
Stiffener Spacing
20 Spaces @ 3'-10" = 76'-8"
24 Spaces @ 3'-10" = 92'-0"
Max. Flg. Rivet Spc. Same all Girders
54"x 3/8" Web
All Intermediate Stiffeners 2 Ls 5"x3 1/2"x 3/8"
For Details of Brg. Pls. See Sheet No.
Abut. #1 Exp'n
Pier #6 Exp'n
Abut. #8 Exp'n
Piers No 2 and 9 Fixed
Piers No's 3, 4, 5, 7, and 8 Exp'n.
ELEVATION-TYPICAL FOR ALL 84'-0" SPANS
ELEVATION-TYPICAL FOR ALL 104'-0" SPANS
Intermediate Stiffeners 2-Ls 5"x3 1/2"x 3/8" Crimped, 5" O.S.L.
Cut 6"x6"x 1/2" L E.S.
Cut 6"x6"x 1/2" L N.S.
C Splice
DETAIL OF END STIFFENERS
DETAIL INTERMEDIATE STIFFENERS
DETAIL OF WEB & FLANGE SPLICES
PLAN OF SPLICE
DETAILS OF STIFFENERS AT PIERS
RIVET SPACING AT ENDS OF 14"x 1/2" COVER PLATES
RIVET SPACING AT ENDS OF 14"x 5/16" COVER PLATES
Reference Drawings for List see Sheet No. 7
COLORADO
STATE HIGHWAY DEPARTMENT
9-CONCRETE PLATE GIRDER SPANS
84, 2@104, 84, 84, 3@104, 84
30'-0" CLEAR ROADWAY
DETAILS OF PLATE GIRDERS
Across Colorado River
Near Grand Junction
Designed by A.D.N.
Made by G.H.W.
Checked by
Approved by
Bridge Engineer
Date: Dec. 10, 1948
H-2-S

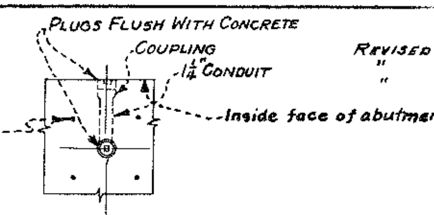
REVISED 6-13-49. J.W.B. Steel Piling
" 7-20-49 E.F.S. Raised Seat
" 10-24-49 L.W.F. Moved Light (Std. out 8"

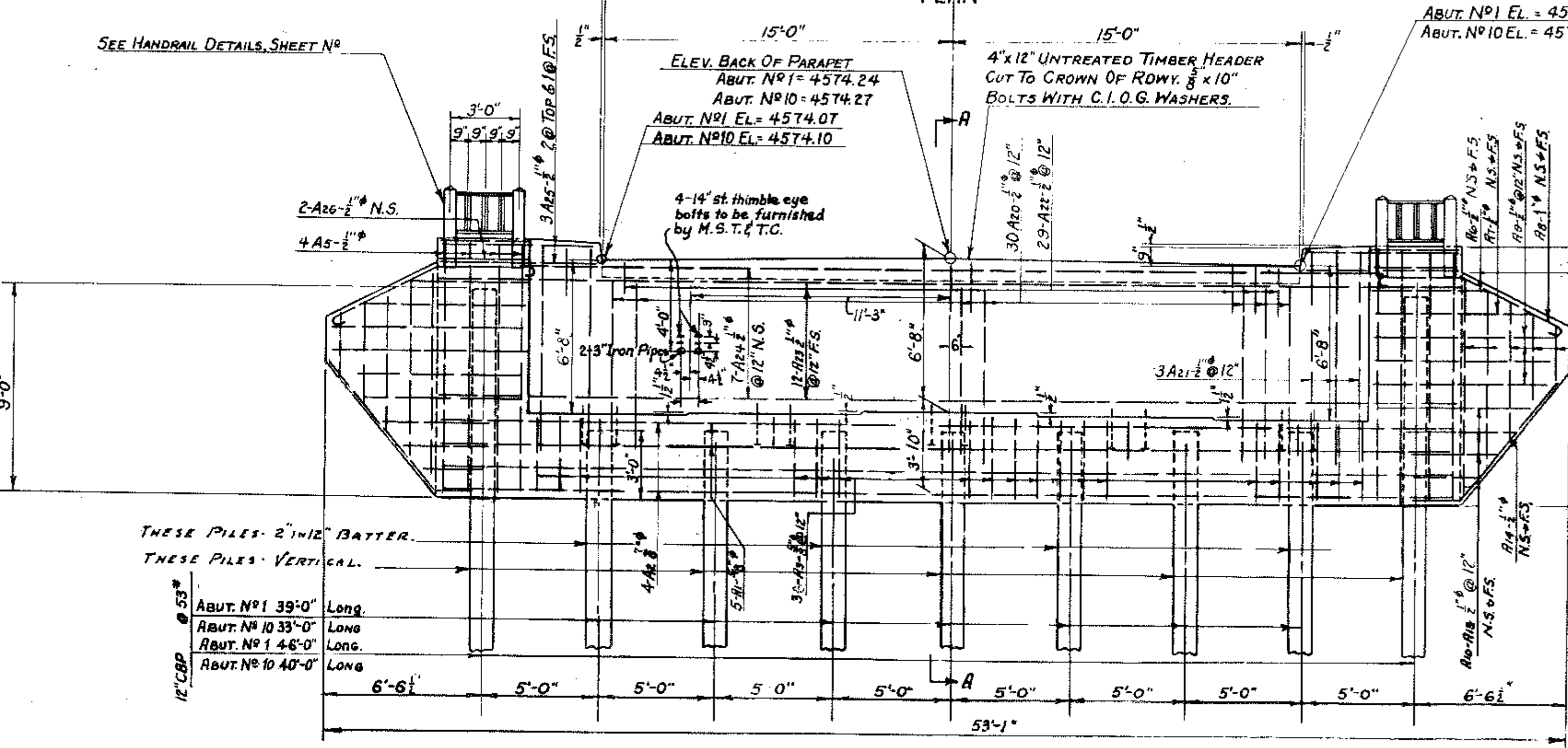
FED. ROAD DIST. NO.	STATE	PROJ. Nº	SHEET No.	TOTAL SHEETS
3	COLO.	S-0143(2)	12	



ANCHOR BOLTS FOR LIGHTING STANDARD. THE CONTRACTOR MUST OBTAIN THE SIZE OF, AND DIMENSIONS FOR SETTING THESE ANCHOR BOLTS FROM THE COMPANY WHICH FURNISHES THE LIGHT STANDARDS.

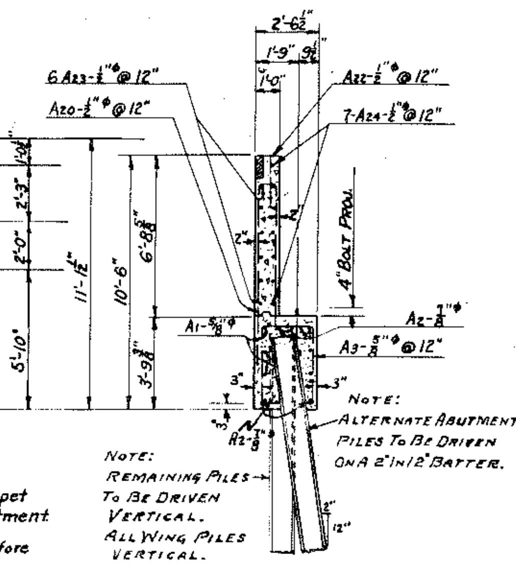
PLAN





Note~ Structural Steel shall be in place before parapet is poured.

Note~ Make a construction joint without key between parapet wall and sidewalls of abutment. Place and compact fill before driving Piles.



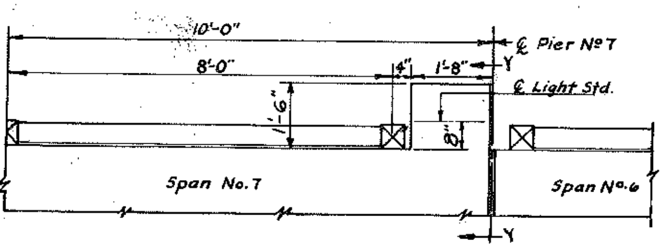
SECTION "A-A".

Note~ Position of pipes and bolts for telephone cable as shown for Abut. No. 1 opposite hand for Abut. No. 10

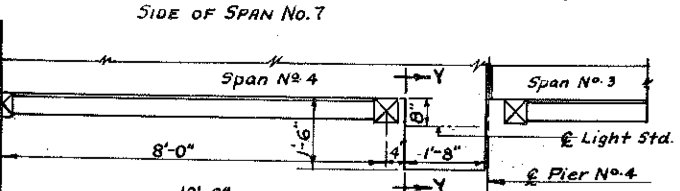
ELEVATION

MAX. PILE LOAD = 40.9 TONS

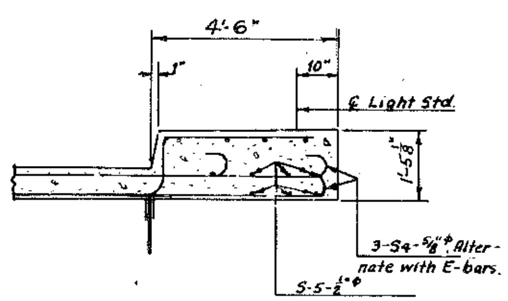
DETAILS OF ABUTMENTS Nº 1 AND Nº 10



PLAN AT LIGHT STANDARD ON DOWNSTREAM SIDE OF SPAN No. 7



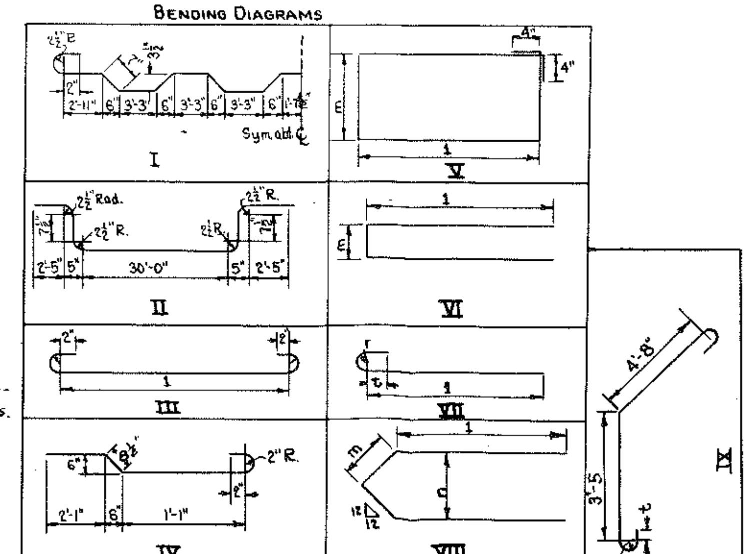
PLAN AT LIGHT STANDARD ON UP-STREAM SIDE OF SPAN Nº 4



SECTION Y-Y

Note~ Attention is called to note concerning Light Standard Anchor Bolts.

BENDING DIAGRAMS



BAR LIST~ SUPERSTRUCTURE						
MARK	SIZE	NO. REQ'D	LENGTH	TYPE	DIM. l	TOTAL LENGTH
E1	5/8"φ	568	34'-11"	I		19833
E2	5/8"φ	1145	37'-5"	II		42843
E3	5/8"φ	1145	34'-3"	III	32'-7	39217
E4	1/2"φ	52	4'-6½"	IV		237
E5	1/2"φ	12	6'-6"	Str.		78
D1	1/2"φ	675	29'-5"	Str.		19857
D2	1/2"φ	225	29'-1"	Str.		6544
D3	1/2"φ	1125	36'-0"	Str.		40500
S1	1/2"φ	60	29'-5"	Str.		1765
S2	1/2"φ	60	29'-6"	Str.		1770
S3	1/2"φ	150	36'-0"	Str.		5400
S4	5/8"φ	12	6'-0"	VII		72
S5	1/2"φ	12	1'-4"	Str.		16

BAR SUMMARY FOR SUPERSTRUCTURE
76,167 Lin. Ft. ½"φ @ .668#/Lin. Ft. = 50880
101,965 " " ⅝"φ @ 1.043#/ " " = 106350
± 1% Overrun = 1570
Total = 158800#

BAR SUMMARY~ ABUT. Nº 1 - ABUT. Nº 10 SAME AS 1
43 Lin. Ft. 1"φ @ 2.67#/Lin. Ft. = 115
312 " " ⅞"φ @ 2.044# " " = 638
608 " " ⅝"φ @ 1.043# " " = 634
1783 " " ½"φ @ .668# " " = 1191
± 1% = 22
Total 2600

BAR LISTS~~ ABUTMENTS Nº 1 AND Nº 10							
MARK	SIZE	Nº REQ'D	LENGTH	TYPE	DIMENSION l	DIMENSION m	TOTAL LENGTH
A1	5/8"φ	5	43'-8"	Str.			218
A2	7/8"φ	8	39'-0"	Str.			312
A3	5/8"φ	36	10'-10"	V	3'-1"	2'-0"	390
~~A4~~	~~5/8"φ~~	~~5~~	~~7'-2"~~	~~V~~	~~1'-3"~~	~~2'-0"~~	~~36~~
A5	1/2"φ	8	25'-10"	V	10'-7"	2'-0"	207
A6	1/2"φ	4	5'-0"	Str.			20
A7	1/2"φ	4	6'-8"	Str.			27
A8	1"φ	4	10'-9"	IX	Dim. r 4"	Dim. t 3½"	43
A9	1/2"φ	12	7'-8"	Str.			90
A10 to A13	1/2"φ	4 ea.	5'-0" by 9" to 2'-9"	Str.			62
A14	1/2"φ	4	9'-0"	Str. Field Bend			36
A15 to A19	1/2"φ	4 ea.	2'-6" by 1'-9" to 9'-6"	Str.			120
A20	1/2"φ	30	16'-4"	VI	7'-10"	0'-8"	490
A21	1/2"φ	6	19'-6"	VI	9'-5"	0'-8"	117
A22	1/2"φ	29	2'-0"	Str.			58
A23	1/2"φ	6	40'-8"	Str.			243
A24	1/2"φ	7	37'-0"	Str.			259
A25	1/2"φ	6	6'-8"	Str.			40
A26	1/2"φ	4	3'-8"	Str.			15

Above Lists for One Abutment

BAR LISTS FOR PIERS 2, 3, 4, 5, 6, 7, 8, AND 9

MARK	SIZE	LENGTH	TYPE	DIMENSIONS l	m	n	r	t	NUMBER REQ'D PIER 2	PIER 3	PIER 4	PIER 5	PIER 6	PIER 7	PIER 8	PIER 9
W1	7/8"φ	11'-1"	III	8'-9"			3½"	3"	78							
W2	1/2"φ	38'-6"	Str.						10	9	9	9	9	9	9	9
W3	3/4"φ	8'-11"	VII	7'-11"			3"	2½"	70							
W4	5/8"φ	5'-6"	VII	4'-8"			2½"	2"	70							
W5	5/8"φ	24'-2"	Str.						64							64
W6	5/8"φ	34'-10"	Str.						6							
W7	5/8"φ	38'-2"	Str.						70							
W8	1/2"φ	33'-0"	Str.						78	72	64	64	70	64	64	70
W9	1/2"φ	7'-1"	VIII	2'-6"	1'-0½"	1'-6"			2	2	2	2		2	2	2
W10	1/2"φ	7'-1¾"	VIII	2'-6"	1'-0⅝"	1'-6½"			2	2	2	2		2	2	2
W11 To W40	1/2"φ	7'-2½" by ¾" to 9'-0¼"	VIII	2'-6"	1'-1¼" by ⅜" to 2'-0⅝"	1'-7" by ½" to 2'-9½"			2 EA.	2 EA.	2 EA.	2 EA.	2 EA.	2 EA.	2 EA.	2 EA.
W41	1/2"φ	9'-1"	VIII	2'-6"	2'-0⅝"	2'-10"			2	2						2
W42	1/2"φ	9'-1¾"	VIII	2'-6"	2'-0⅞"	2'-10½"			2	2						2
W43	1/2"φ	9'-2½"	VIII	2'-6"	2'-1¼"	2'-11"			2	2						2
W44	1/2"φ	9'-3¼"	VIII	2'-6"	2'-1⅜"	2'-11½"			2	2						
W45	1/2"φ	9'-4"	VIII	2'-6"	2'-2"	3'-0"			2							
W46	1/2"φ	9'-4¾"	VIII	2'-6"	2'-2⅝"	3'-0½"			2							
W47	1/2"φ	9'-5½"	VIII	2'-6"	2'-2¾"	3'-1"			2							
W48	3/4"φ	10'-4"	III	8'-4"			3"	2½"		67						
W49	5/8"φ	5'-2"	VII	4'-4"			2½"	2"		74	74	74	74	74	74	
W50	5/8"φ	35'-8"	Str.							74						
W51	5/8"φ	9'-1"	III	7'-5"			2½"	2"			78	78	78	78	78	
W52	5/8"φ	31'-8"	Str.								74	74	74	74	74	
W53	1/2"φ	9'-2"	V	2'-8"	1'-7"								34			
W54	3/4"φ	10'-1"	III	8'-1"			3"	2½"								85
W55	5/8"φ	7'-4"	VII	6'-6"			2½"	2"								70
W56	1/2"φ	4'-5"	VII	3'-9"			2"	2"								70
W57	5/8"φ	32'-6"	Str.													8
W58	1/2"φ	34'-8"	Str.													70
W59	1/2"φ	8'-8½"	VIII	2'-6"	1'-10¼"	2'-7"							4			

BAR SUMMARY - PIER Nº 2
3605 Lin. Ft. ½"φ @ 0.668# Per Lin. Ft. = 2408
4813 " " ⅝"φ @ 1.043# " " " = 5020
625 " " ¾"φ @ 1.502# " " " = 939
865 " " ⅞"φ @ 2.044# " " " = 1768
± 1% Overrun = 105
Total = 10,240#

BAR SUMMARY ~ PIER Nº 3
3312 Lin. Ft. ½"φ @ 0.668# Per Lin. Ft. = 2212
3022 " " ⅝"φ @ 1.043# " " " = 3152
693 " " ¾"φ @ 1.502# " " " = 1041
± 1% Overrun = 65
Total: 6470#

BAR SUMMARY - PIER Nº 4 - PIERS 5, 7, 8 SAME
2974 Lin. Ft. ½"φ @ 0.668# Per Lin. Ft. = 1987
3435 " " ⅝"φ @ 1.043# " " " = 3583
± 1% Overrun = 60
Total = 5830#

BAR SUMMARY ~ PIER Nº 6
3490 Lin. Ft. ½"φ @ 0.668# Per Lin. Ft. = 2331
3435 " " ⅝"φ @ 1.043# " " " = 3583
± 1% Overrun = 56
Total = 5970

BAR SUMMARY ~ PIER Nº 9
5963 Lin. Ft. ½"φ @ 0.668# Per Lin. Ft. = 3983
2255 " " ⅝"φ @ 1.043# " " " = 2352
857 " " ¾"φ @ 1.502# " " " = 1287
± 1% Overrun = 78
Total = 7700

Reference Drawings for List see Sheet No. 7

COLORADO
STATE HIGHWAY DEPARTMENT

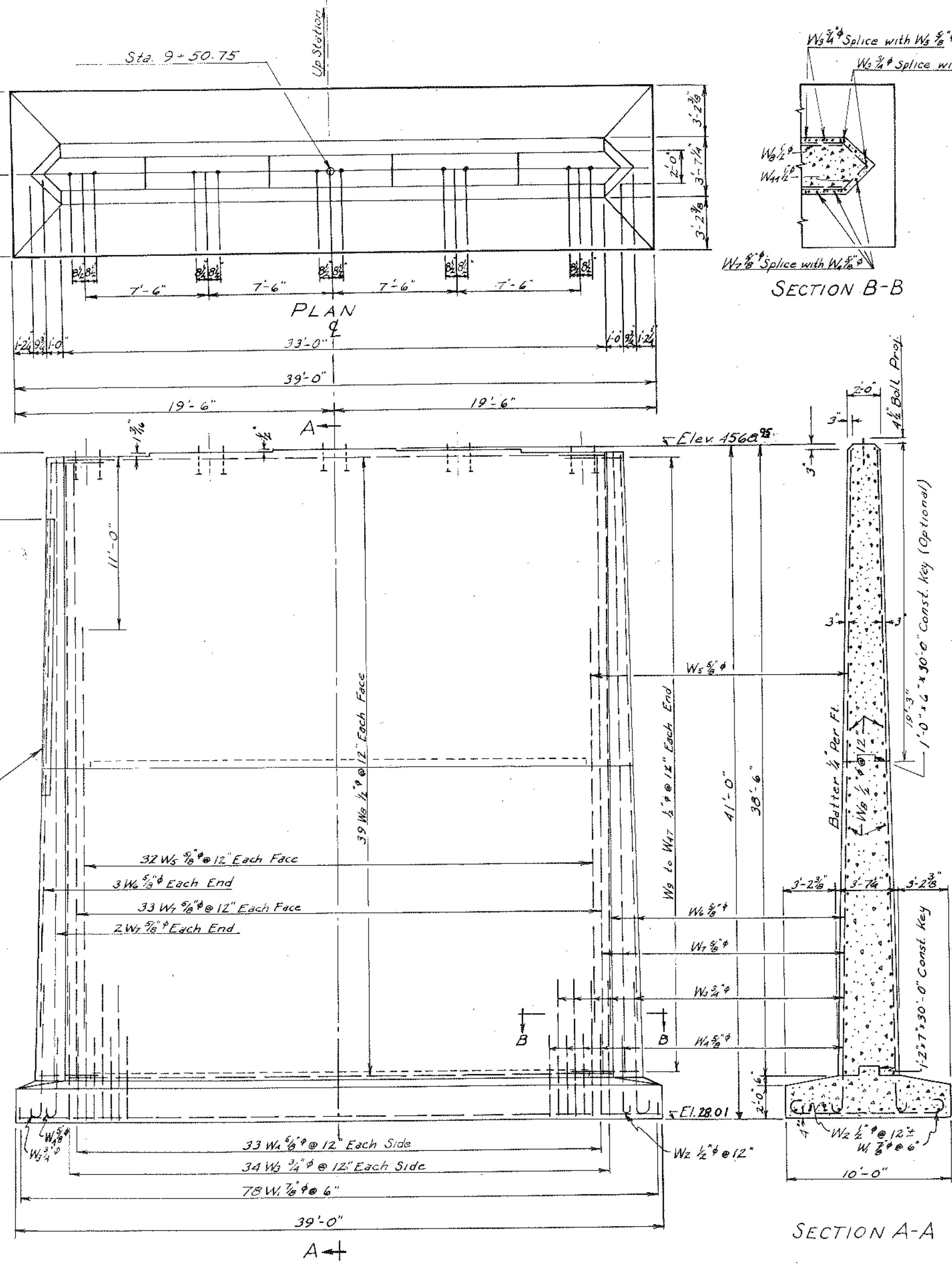
9-SPANS (84', 2@104', 84-84, 3@104, 84')
PLATE GIRDER SPANS
30'-0" CLEAR ROADWAY
DETAILS OF ABUTMENTS Nº 1 & Nº 10

Across COLORADO RIVER
Sta. 8+65 To 17+26.08
Near GRAND JUNCTION Sec. 15 T. 1 S R. 100W

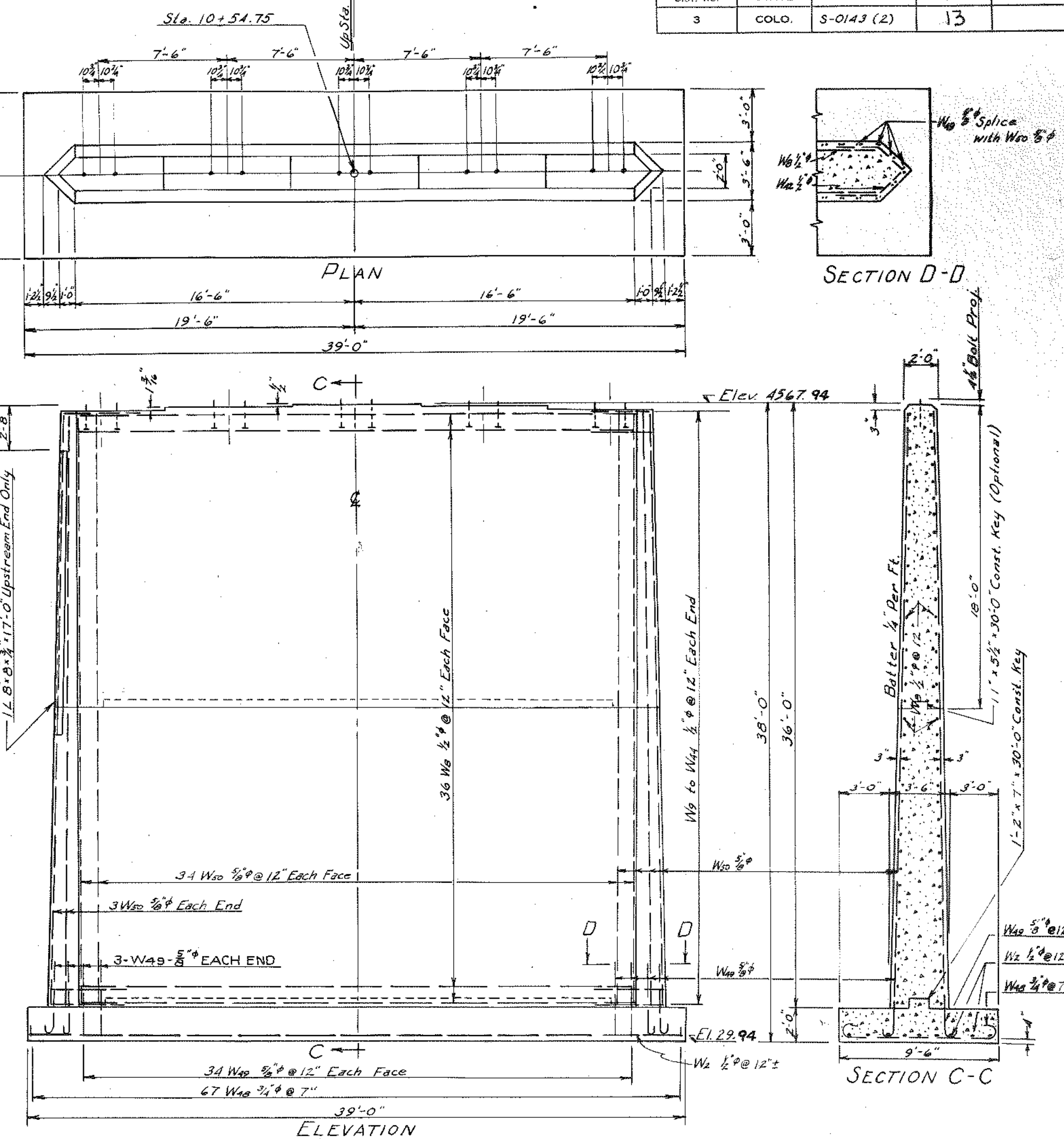
Designed by A.D.N. Made by G.H.W. Checked by	Approved by P. J. Bailey Bridge Engineer Date: Dec. 10, 1948.

STRUCTURE NO. H-2-S

FED. ROAD DIST. NO.	STATE		SHEET NO.	TOTAL SHEETS
3	COLO.	S-0143 (2)	13	



DETAILS PIER No 2
Max. Soil Pressure = 2.8 Tons / Sq. Ft.



DETAILS PIER No 3
Max. Soil Pressure = 2.0 Tons / Sq. Ft.

Cu. Yds. Concrete	Pier 2	Pier 3
Wall	34	27.5
Footing	138	126.5
Total	172	154

Reference Drawings
See Sheet No. 7 for detail list

REFERENCE DRAWINGS:
For List See Sheet No 7

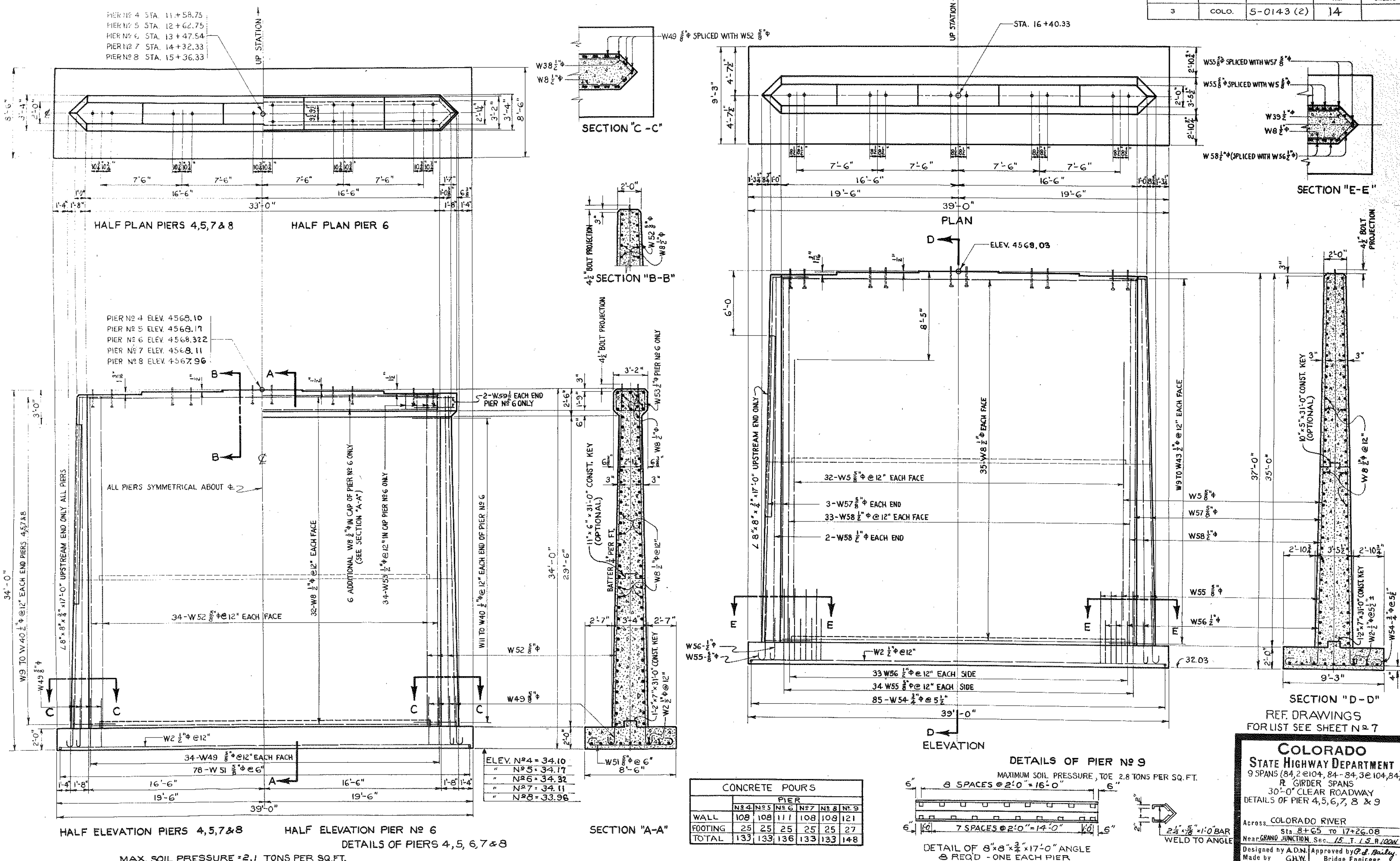
STRUCTURE No H-2-S

COLORADO
STATE HIGHWAY DEPARTMENT
9 Spans (84, 2@104, 84-84, 3@104, 84)
PL Girder Spans
30'-0" Clear Roadway
DETAILS PIERS No 2 & No 3
Across Cole River
Sta. 8+65 to 17+26.08
Near Grand Junction Sec. 15 T. 1S R. 100W

Designed by ADN
Made by GHW
Checked by

Approved by C. S. Bailey
Bridge Engineer
Date: Dec. 10, 1948.

FED. ROAD DIST. NO.	STATE		SHEET NO.	TOTAL SHEETS
3	COLO.	5-0143 (2)	14	



CONCRETE POURS

	PIER					
	Nº 4	Nº 5	Nº 6	Nº 7	Nº 8	Nº 9
WALL	108	108	111	108	108	121
FOOTING	25	25	25	25	25	27
TOTAL	133	133	136	133	133	148

STRUCTURE Nº H-2-S

COLORADO
STATE HIGHWAY DEPARTMENT
9 SPANS (84, 2 @ 104, 84-84, 3 @ 104, 84) Ⓟ GIRDER SPANS
30'-0" CLEAR ROADWAY
DETAILS OF PIER 4, 5, 6, 7, 8 & 9

Across COLORADO RIVER
Sta. 8+65 to 17+26.08
Near GRAND JUNCTION Sec. 15 T. 1 S R. 100W

Designed by A.D.N. Made by G.H.W. Checked by
Approved by P. L. Bailey, Bridge Engineer
Date: Dec. 10, 1948.

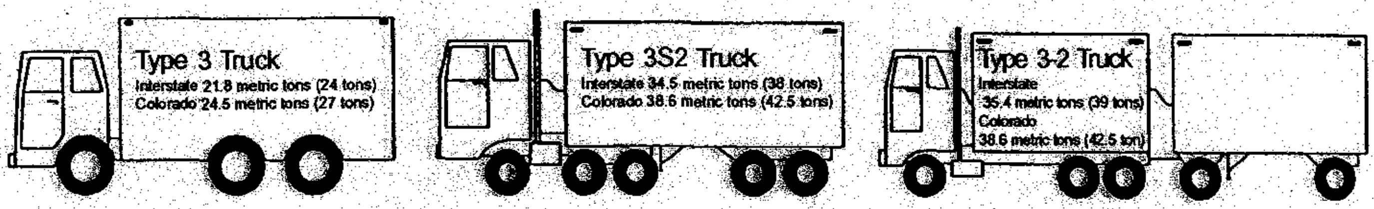
COLORADO DEPARTMENT OF TRANSPORTATION

LOAD FACTOR RATING SUMMARY

Structure #	H-04-G
State highway #	330
Batch I.D.	BID# 1144
Structure type	CIC
Parallel structure #	NONE

Rated using
Asphalt thickness: 216 mm (8.5 in.)
☒ Colorado legal loads
☐ Interstate legal loads

Structural member	DECK SLAB **	INTERIOR GIRDER GIRDERS C THRU E	INTERIOR GIRDER GIRDER B	EXTERIOR GIRDER GIRDER A
	Metric tons (Tons)			
Inventory	28 (31)	27 (30)	25 (27)	126 (139)
Operating	47 (52)	45 (50)	42 (46)	210 (232)
Type 3 truck	( )	( )	( )	( )
Type 3S2 truck	( )	( )	( )	( )
Type 3-2 truck	( )	( )	( )	( )
Permit truck	( )	107 (118)	103 (113)	386 (425)



Type 3 Truck		Type 3S2 Truck		Type 3-2 Truck	
Metric tons	(Tons)	Metric tons	(Tons)	Metric tons	(Tons)

Comments

Modified Tandem: 55 (61) 62 (69) 201 (221)
**Assumed Slab reinforcing
Control Member: Interior Girder B; Rated for 8.5" HBP
Load Capacity: 46 Tons
Girder: Interior Girder Rated for 8.5" HBP

Color Code: WHITE

Project No: C-08-330-530

Rated by	Date	Checked by	Date
Andy Pott	11/10/03	ALI HARAJLI, PE I	11/10/03

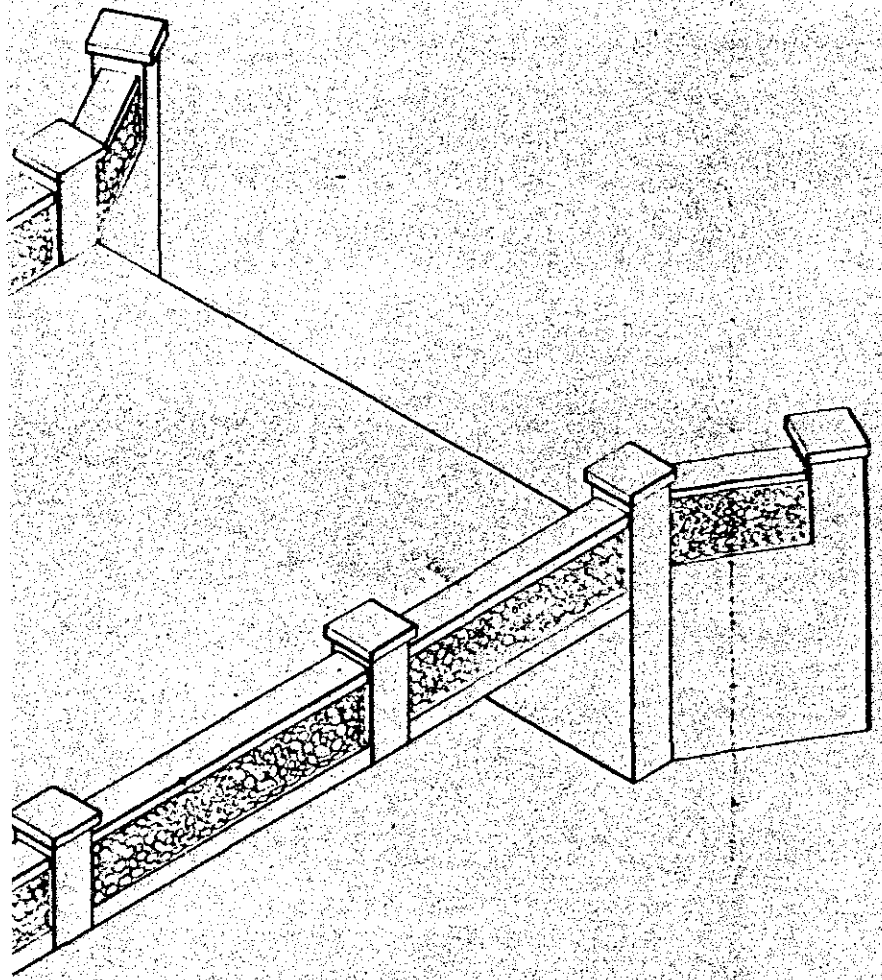
Previous editions are obsolete and may not be used

CDOT Form #1187a 1/95

PLAN OF
PROPOSED CONCRETE BRIDGE
LOCATED AT
BIG CREEK – MILE POST 41.9
STATE ROAD 65

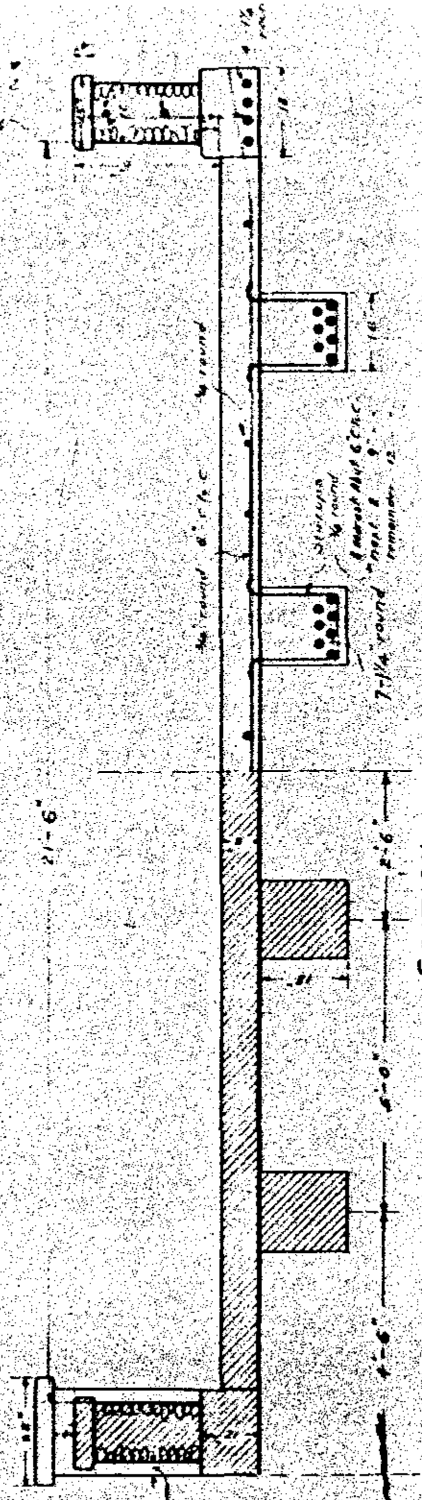
MESA COUNTY, COLO. Mar. 12, 1918.

E.R. Romberg
Gen. Road Supervisor

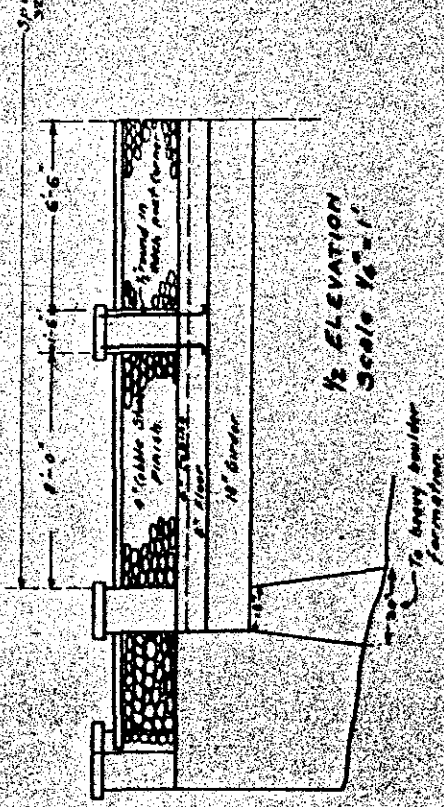


COST ESTIMATE

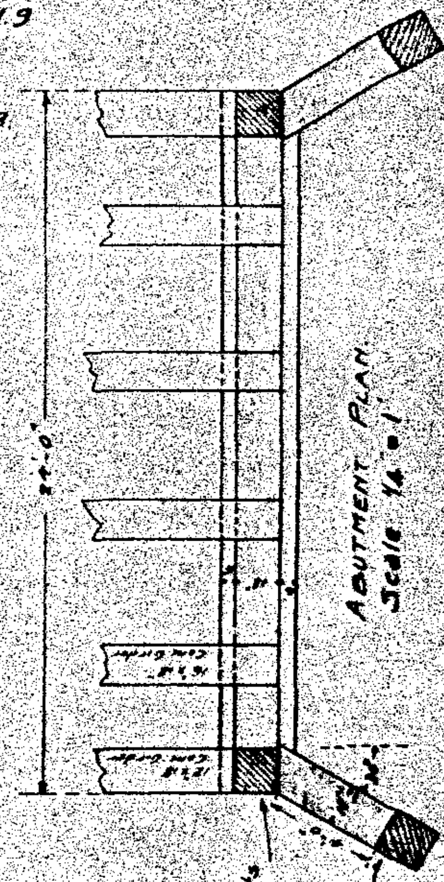
	Excavation	\$ 50.00
(\$14 per yd inc. forms)	67 Cu. yds. 1:4 Concrete	938.00
8 cts. per lb	9000# Reinforcement	720.00
	Total	1708.00



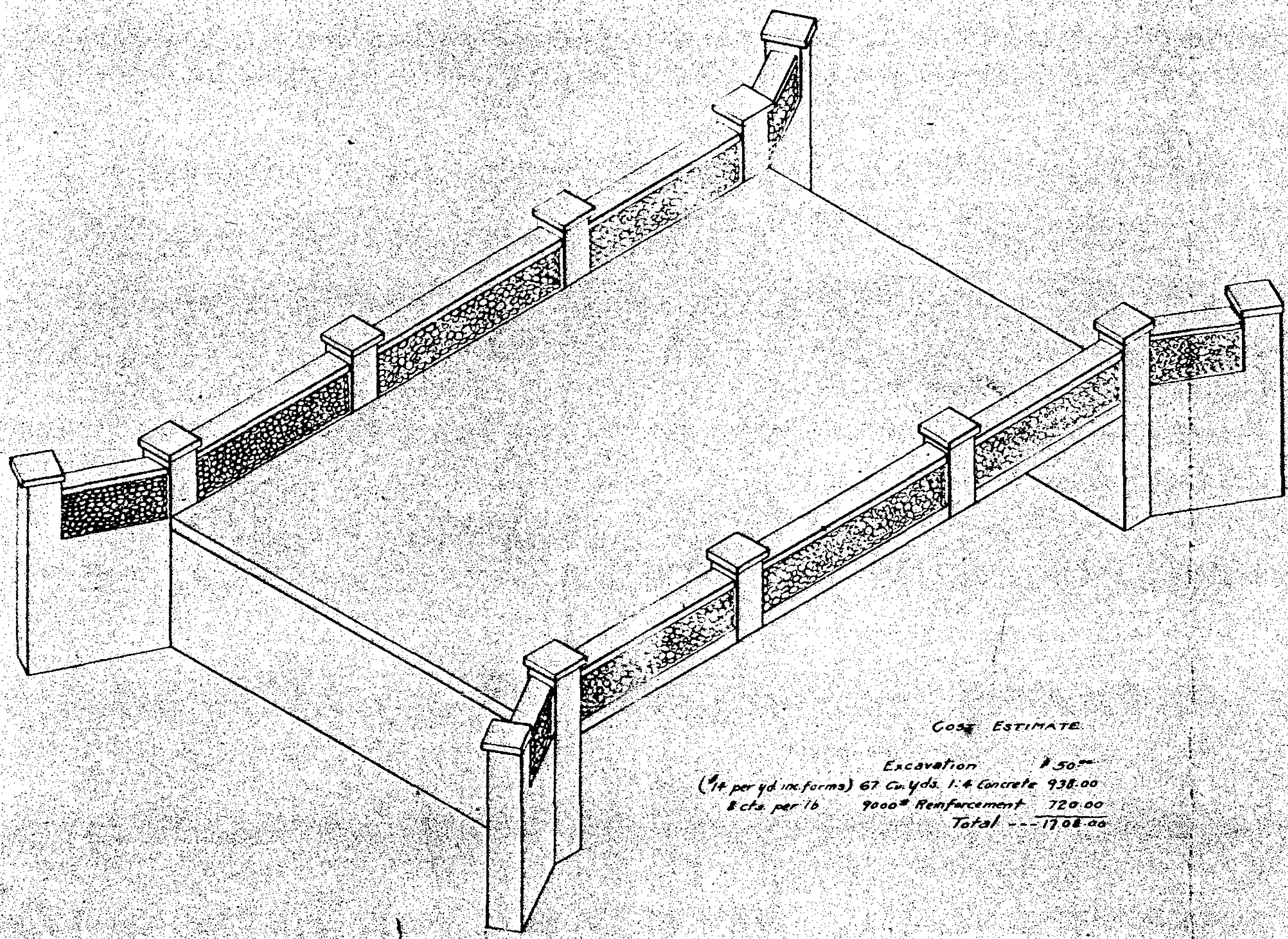
SECTION.
Scale ½" = 1'



½ ELEVATION
Scale ¼" = 1'

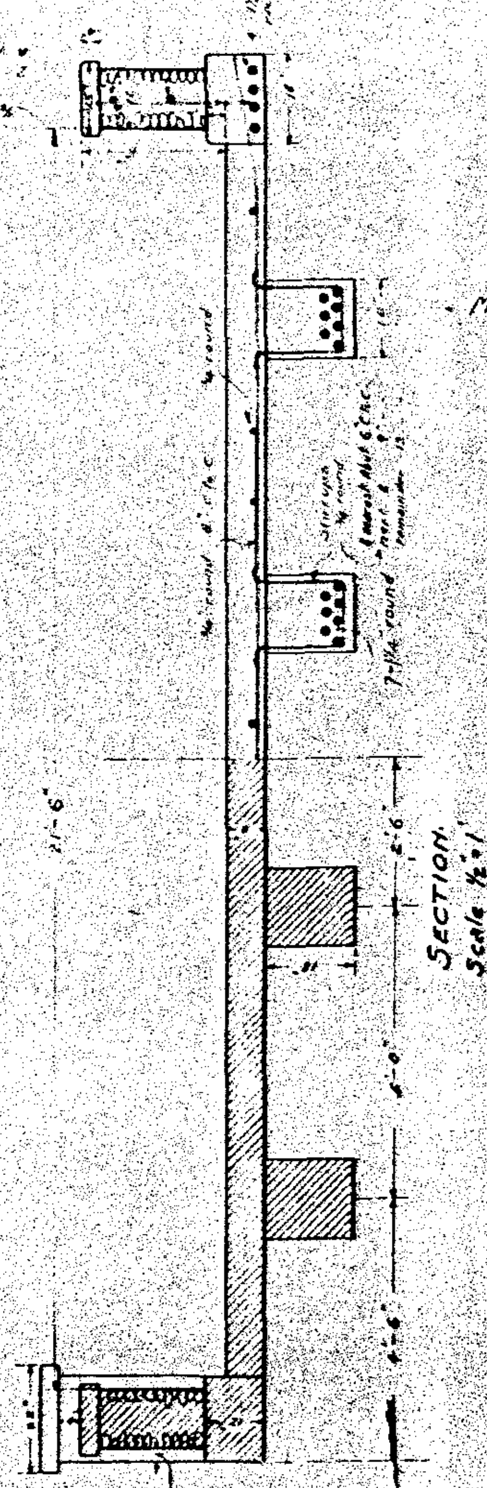


ABUTMENT PLAN.
Scale ¼" = 1'

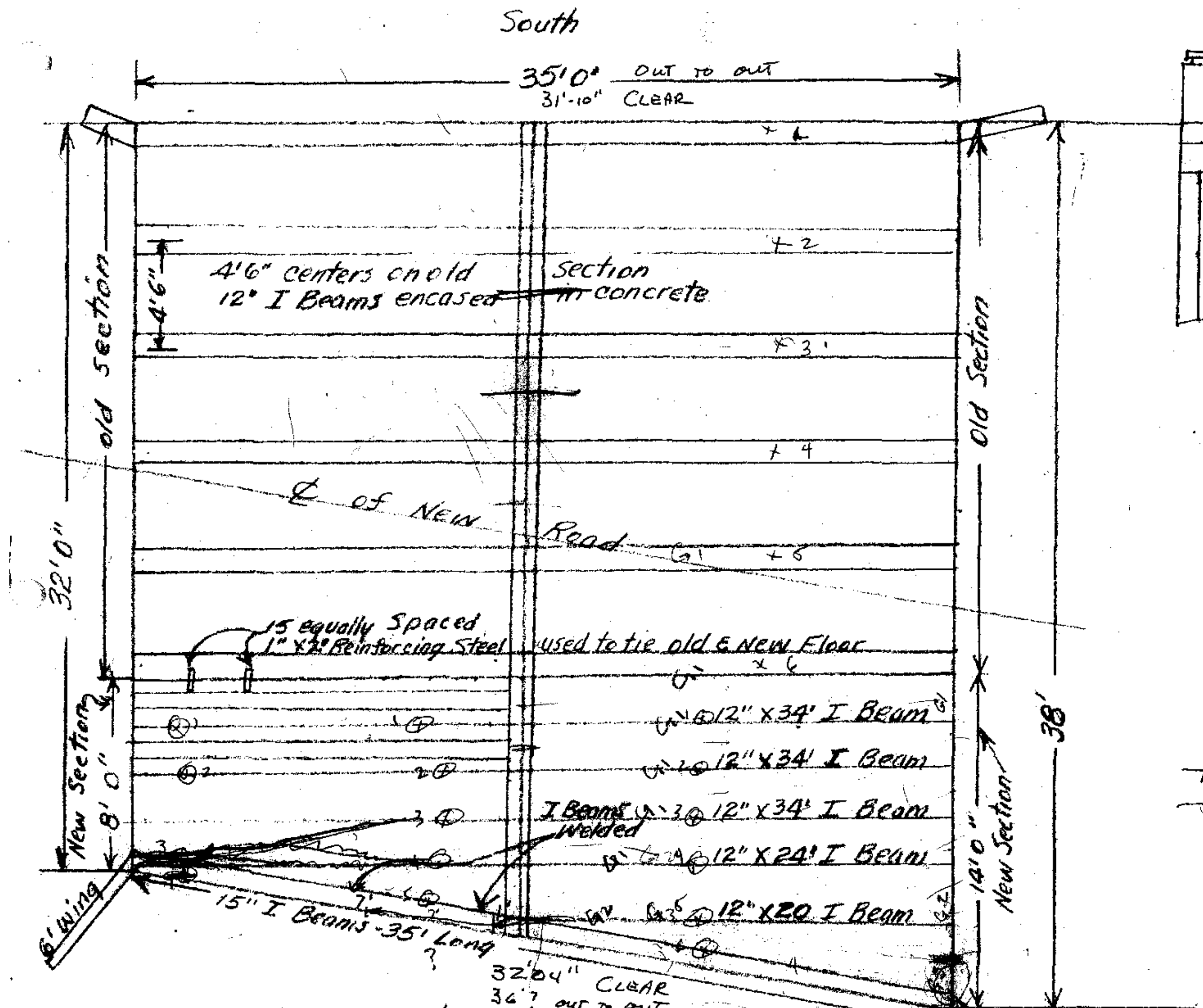


COST ESTIMATE

		Excavation	$50.00
($14 per yd inc. forms)	67 Cu. yds. 1:4 Concrete		938.00
8 cts. per lb	9000# Reinforcement		720.00
		Total	1708.00

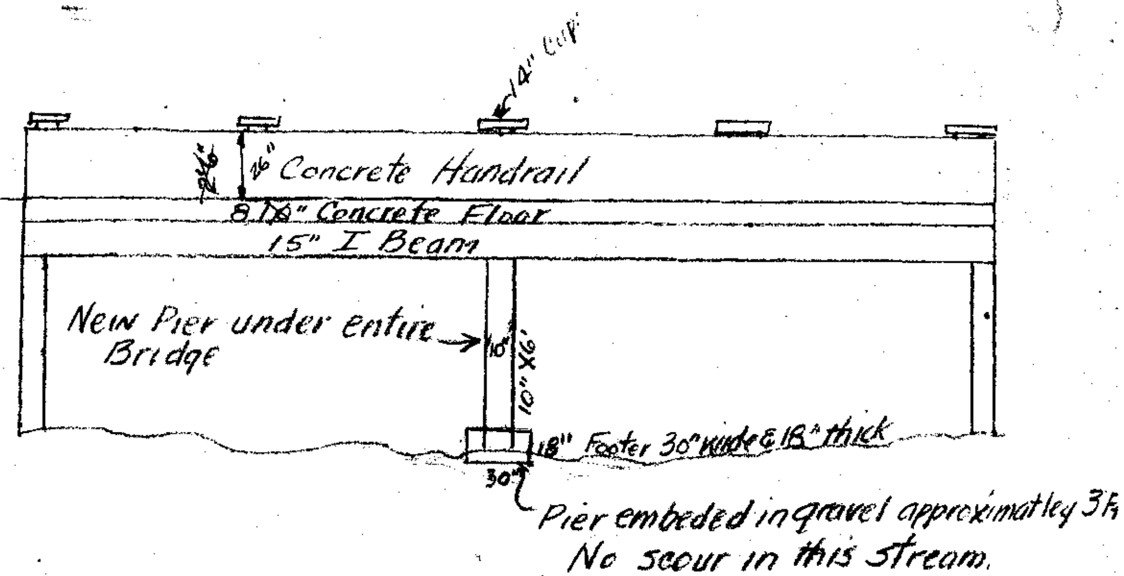


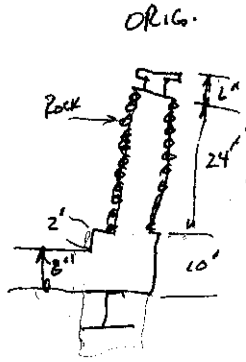
SECTION
Scale ½"=1'



8-5/8" Reinforcing Steel running lengthwise.
6-5/8" Reinforcing Steel running crosswise.
Upon which is a mat of 1/4" x 4" Steel Mesh.
10" Concrete Floor to match old section.

14/12





Details of Bridge Widening across
Big Creek on SP-8-330-503,
Molina - Plateau City

St. H-4-G

Rerated for 6
CARDEX has H-8
No when near
275 246

Check General
Scour = 3
Check Sub Struc.
H-4-G

PLAN OF

PROPOSED CONCRETE BRIDGE

LOCATED AT

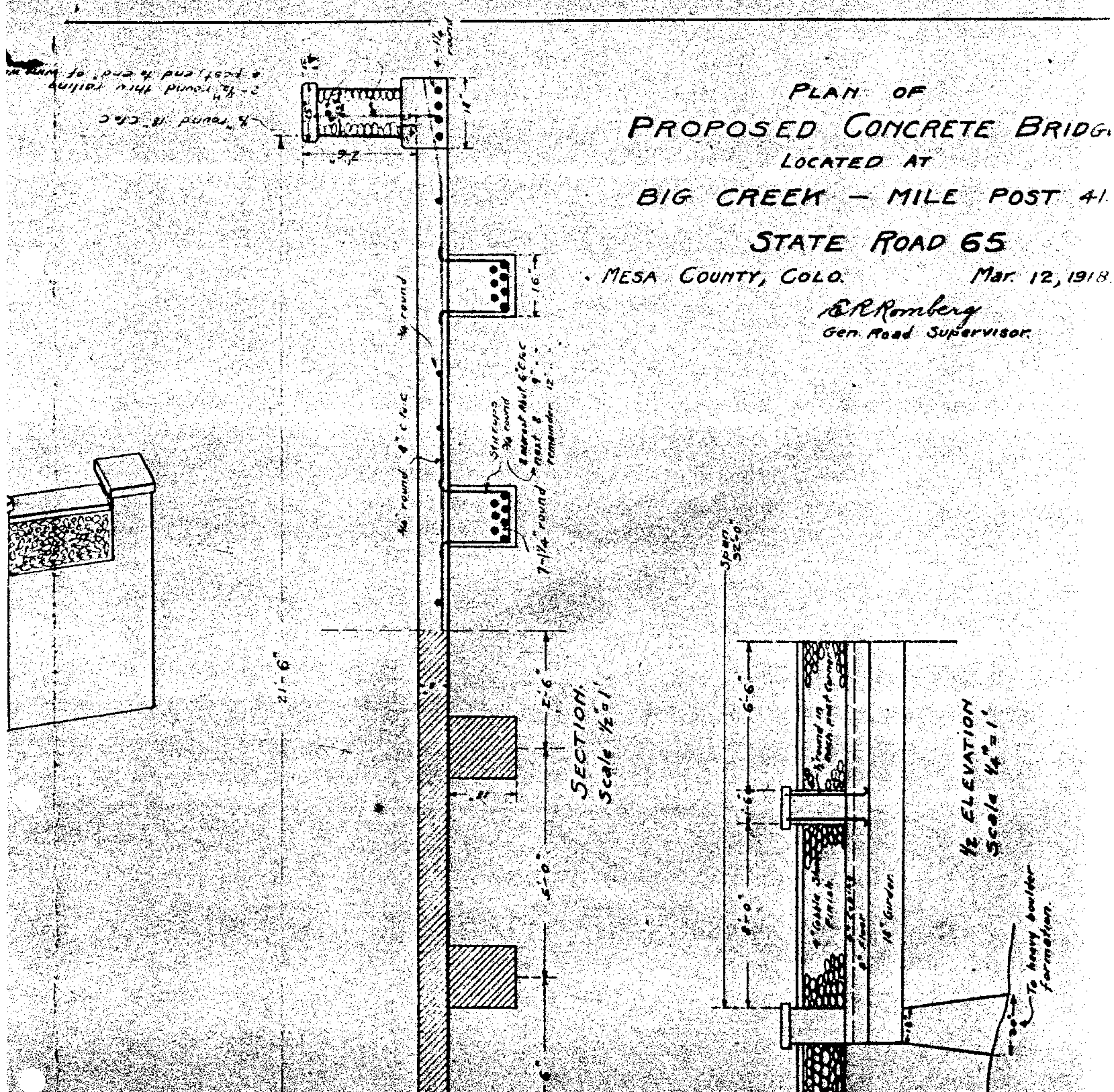
BIG CREEK — MILE POST 41

STATE ROAD 65

MESA COUNTY, COLO. Mar. 12, 1918.

E.R. Romberg

Gen. Road Supervisor.



DIVISION OF HIGHWAYS—STATE OF COLORADO
DOH FORM NO. 117
REV. DEC 1972

FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	BR 5 0330(3)	9	60

AS CONSTRUCTED
REVISED DATE 1-4-75

REVISIONS			
R-1	6/13/74	ITEM 613	K.D.H.
R2	6-27-74	Replaced Elastomeric Pads with steel Ps I/A/W C.O.# 05765	RRA

GENERAL NOTES

ALL WORK SHALL BE DONE ACCORDING TO THE STANDARD SPECIFICATIONS OF THE DIVISION OF HIGHWAYS, STATE OF COLORADO, APPLICABLE TO THE PROJECT.

ALL CONCRETE SURFACES MARKED WITH THE SYMBOL *f* AS SHOWN ON DRAWING NO. B 14 SHALL RECEIVE A CLASS 2 SURFACE FINISH.

ALL CONCRETE CHAMFERS SHALL BE 3/4 INCH UNLESS OTHERWISE NOTED.

EXPANSION JOINT MATERIAL SHALL MEET A.A.S.H.O. SPECIFICATION M 213-65 AND SHALL BE INCLUDED IN THE PAYMENT FOR ITEM NO. 601.

SOUNDINGS AND DEPTH OF FOOTINGS ARE IN ACCORDANCE WITH THE BEST AVAILABLE DATA. WHEN DIFFERENT CONDITIONS ARE ENCOUNTERED, THE BRIDGE ENGINEER WILL INSPECT AND DETERMINE IF REDESIGN IS NECESSARY.

WHEN EXCAVATING FOR FOOTINGS, THE FINAL SIX INCHES IN DEPTH SHALL BE DONE BY HAND LABOR METHODS.

FOOTINGS IN ROCK SHALL NOT BE FORMED BUT SHALL BE PLACED AGAINST UNDISTURBED ROCK.

FOR DETAILS OF STRUCTURE EXCAVATION AND STRUCTURE BACKFILL, SEE STANDARD M-206-AA.

ALL STRUCTURAL STEEL NOT OTHERWISE NOTED SHALL BE A.A.S.H.O. SPECIFICATION M-183.

ALL STRUCTURAL STEEL NOT OTHERWISE NOTED SHALL BE PAINTED IN ACCORDANCE WITH SECTION 509 FOR (*ALUMINUM*) PAINT.

ALL BOLTS SHALL BE 3/4" DIAMETER, HIGH STRENGTH, UNLESS OTHERWISE NOTED.

NO WELDING OF ANY KIND SHALL BE PERMITTED ON THE FLANGES OF STEEL GIRDERS UNLESS SPECIFICALLY CALLED FOR IN THE PLANS.

USE GRADE 60 FOR ALL REINFORCING STEEL, EXCEPT TIES AND STIRRUPS. ALL TIES AND STIRRUPS ARE GRADE 40.

THE FOLLOWING TABLE SHOWS THE MINIMUM LAP FOR COMMON BAR SIZES.

BAR SIZE NUMBER		4	5	6	7	8	9	10	11
SPLICE	GRADE 40	1'-0"	1'-3"	1'-6"	1'-9"	2'-2"	2'-8"	3'-5"	4'-3"
LENGTH	GRADE 60	1'-6"	1'-11"	2'-3"	2'-8"	3'-0"	3'-5"	4'-2"	5'-0"

E. F. = EACH FACE
N. F. = NEAR FACE
F. F. = FAR FACE

B — CROSS REFERENCE DRAWING NUMBER
SECTION OR DETAIL IDENTIFICATION

	INITIAL	DATE			
DESIGNED BY	RRA	4-73	CHECKED BY		
CHECKED BY	J.H.	8-73	QUANTITIES BY	L.S.	8-73
DETAILED BY	L.S.	9-73	CHECKED BY	B.E.	8-73

Concrete Deck Shall Recieve a Transverse Fiber Broom Finish
Location of all construction joints shall be approved by the engineer.

SUMMARY OF QUANTITIES   REFERENCE Bk 1, Pg. 17

ITEM	DESCRIPTION	UNIT	Super-structure	Abut. 1	Pier 2	Abut. 3	Totals
202	Removal of Bridge	Ea.					1
204	Haul	Ton. Mi	57				57
206	Structure Excavation	Cu. Yd.		234	65	264	563
206	Structure Backfill (Class 2)	Cu. Yd.		52	38	54	144
403	Hot Bituminous Pavement (Grading E)	Ton	53				53
411	Asphalt Cement (AC-5)	Ton	3.08 ~~3~~				3.08 ~~3~~
502	Steel Piling (HP 12 x 74)	Lin. Ft.		161 ~~165~~	85 ~~92~~	123 ~~120~~	369 ~~377~~
502	STEEL PILING (HP12X74) CUTOFF	Lin. Ft.		12	17	12	41
502	Reinforcing Tips	Ea.		5	8	5	18
506	Heavy Riprap	Cu. Yd		684.5 ~~540~~		578.5 ~~738~~	1263 ~~1278~~
509	Structural Steel	lb.			453		453
509	Structural Steel (Galvanized)	lb.	12,785				12,785
601	Concrete Class A (Bridge)	Cu. Yd		22.5	106.5	26.0	155
601	Concrete Class D (Bridge)	Cu. Yd	168.0	39.0	40.3	41.7	289
602	Reinforcing Steel	lb.	49,386	6,461	6,964	6,262	69,073
606	Guard Rail Type 3A	Lin Ft	414				414
R-1 613	Place Conduit	Lin. Ft	428				428
618	Prestressed Conc. Unit (I Section) 80' to 85'-0"	Ea.	10				10
R2 (1)	Steel Masonry Plates	Ea.		5	10	5	20

(1) To Be Included in the Bid Price for Item 618 Prestressed Concrete Units

INDEX OF DRAWINGS

BRIDGE DESCRIPTION

2 - Cont. Spans (80'-0", 80'-0")
Concrete Slab and Prestressed Girder Bridge

LOADING DATA

LIVELOAD: A.A.S.H.O. HS 20-44 OR INTERSTATE ALTERNATE
DEADLOAD: ASSUMES 25 LBS. PER SQ. FT. FOR BITUMINOUS PAVEMENT

DESIGN DATA

A.A.S.H.O. UNIT STRESSES, EXCEPT AS NOTED.

REINFORCING STEEL: Fs = 24,000 LBS. PER SQ. IN. EXCEPT
Fs = 20,000 LBS. PER SQ. IN. IN TRANSVERSE DECK SLAB, STIRRUPS AND TIES.

STRUCTURAL STEEL: A36 Fs = 20,000 LBS. PER SQ. IN.
A572, GRADE 50 Fs = 27,000 LBS. PER SQ. IN.

CONCRETE: Fc = 1,200 LBS. PER SQ. IN.
n = 10

Over Plateau Creek
36' Roadway Curb to Curb 40° 00' Skew
1'-3" Curbs, Standard Bridge Rail Type 3

PAUL CHOVARSKY JR. REGISTERED 4687 PROFESSIONAL ENGINEER STATE OF COLORADO

Approved
B.E. 11/21/73
Bridge Engineer Date

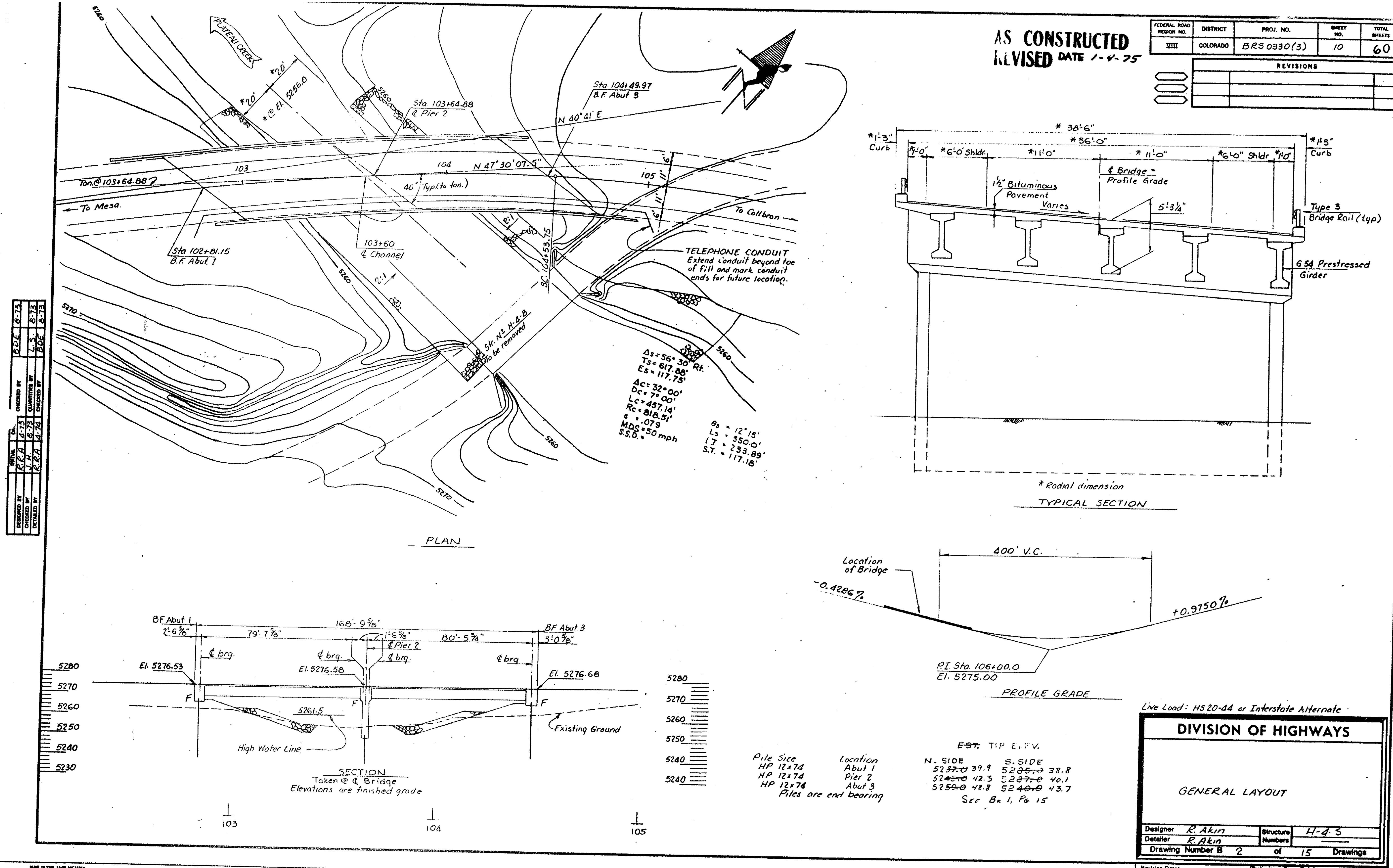
DIVISION OF HIGHWAYS

GENERAL INFORMATION
SUMMARY OF QUANTITIES

Station *102+81.15 to 104+49.97*
Station

Near *Molina* Sec. *16* T. *10S* R. *96 W*
Designer *R. AKIN* | Structure Numbers *H-4-S*
Detailer *L. Sims*
Drawing Number B *1* of *15* Drawings

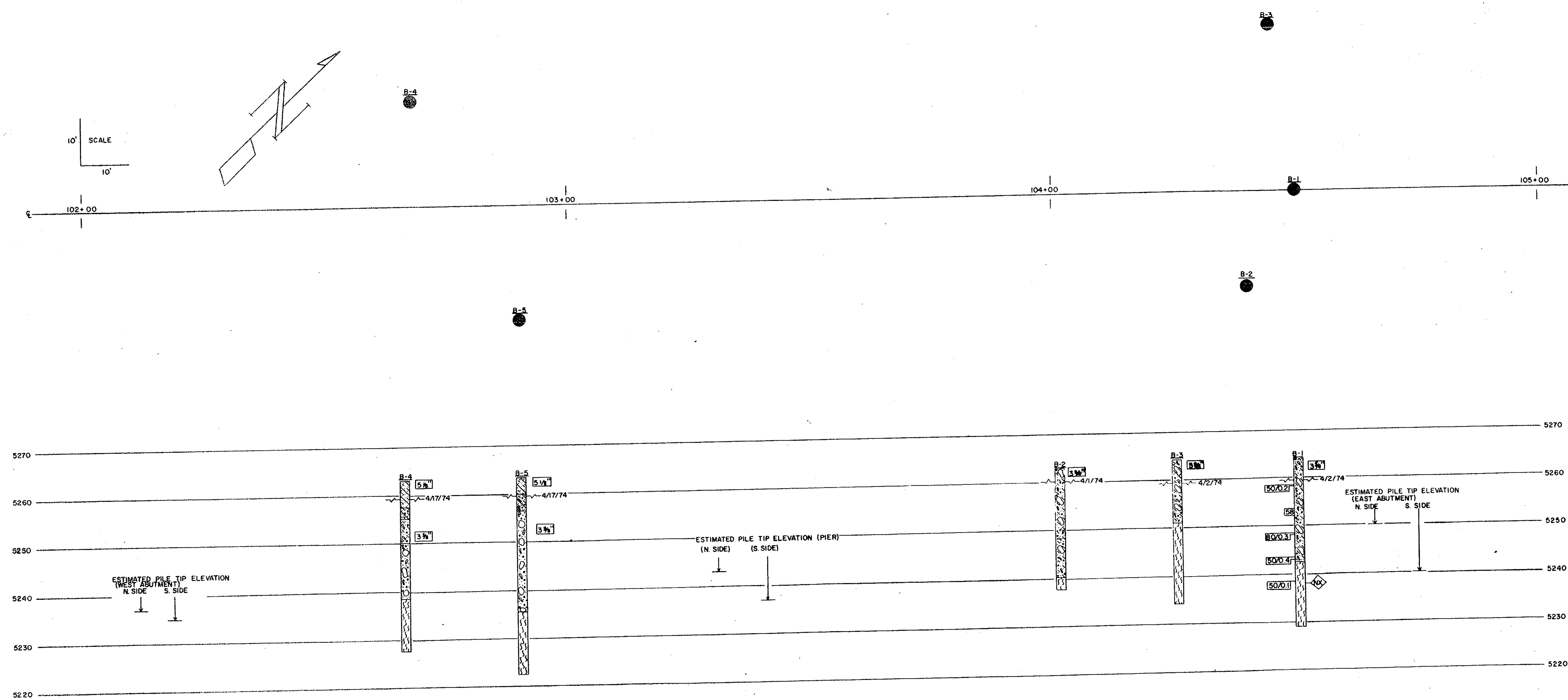
O(4-1-73)



AS CONSTRUCTED
REVISED DATE 1-4-75
FEDERAL ROAD REGION NO. VIII
DISTRICT COLORADO
PROJ. NO. BRS 0330(3)
SHEET NO. 10
TOTAL SHEETS 60
REVISIONS
PLATEAU CREEK
Sta. 104+49.97
B.F. Abut 3
Sta. 103+64.88
℄ Pier 2
N 40° 41' E
*20'
*20'
*@ El. 5256.0
103
104
105
N 47° 30' 07.5"
Tan. @ 103+64.88
40" Typ. (to tan.)
To Mesa
To Collbran
Sta 102+81.15
B.F. Abut 1
103+60
℄ Channel
2:1
2:1
SC 104+53.75
TELEPHONE CONDUIT
Extend conduit beyond toe of fill and mark conduit ends for future location.
Str. No. H-4-B
To be removed
Δs = 56° 30' Rt.
Ts = 617.88'
Es = 117.75'
Δc = 32° 00'
Dc = 7° 00'
Lc = 457.14'
Rc = 818.51'
e = .079
MDS = 50 mph
S.S.D.
θs = 12° 15'
Ls = 350.0'
LT = 233.89'
S.T. = 117.18'
5260
5270
PLAN
* 38'-6"
* 36'-0"
*1'-3" Curb
*1'-0"
*6'-0" Shldr.
*11'-0"
*11'-0"
*6'-0" Shldr
*1'-0"
*1'-3" Curb
1½" Bituminous Pavement
Varies
℄ Bridge = Profile Grade
5'-3¼"
Type 3 Bridge Rail (typ)
G 54 Prestressed Girder
* Radial dimension
TYPICAL SECTION
400' V.C.
Location of Bridge
-0.4286%
+0.9750%
P.I. Sta. 106+00.0
El. 5275.00
PROFILE GRADE
BF Abut 1
168'-9⅝"
2'-6⅜"
79'-7⅝"
1'-6⅝"
80'-5¾"
BF Abut 3
3'-0⅝"
℄ brg.
℄ brg
℄ Pier 2
℄ brg.
℄ brg
El. 5276.53
El. 5276.58
El. 5276.68
5280
5270
5260
5250
5240
5230
5261.5
High Water Line
Existing Ground
SECTION
Taken @ ℄ Bridge
Elevations are finished grade
103
104
105
Pile Size
HP 12x74
HP 12x74
HP 12x74
Location
Abut 1
Pier 2
Abut 3
Piles are end bearing
~~EST.~~ TIP ELEV.
N. SIDE
~~5237.0~~ 39.9
~~5243.0~~ 42.3
~~5259.0~~ 48.8
S. SIDE
~~5235.~~ 38.8
~~5237.0~~ 40.1
~~5240.0~~ 43.7
See Bk 1, Pg 15
Live Load: HS 20-44 or Interstate Alternate
DIVISION OF HIGHWAYS
GENERAL LAYOUT
Designer R. Akin
Detailer R. Akin
Structure Numbers H-4-S
Drawing Number B 2 of 15 Drawings
Revision Dates
(Preliminary Stage Only)
DESIGNED BY R.R.A. 4-73
CHECKED BY BDE 8-73
DETAILED BY J.H. 8-73
QUANTITIES BY L.S. 8-73
DETAILED BY R.R.A. 4-74
CHECKED BY BDE 8-73

FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.	TOTAL SHEETS
VIII	COLO.	BRS C330(3)	11	60

AS CONSTRUCTED
NO REVISIONS DATE 1-4-75



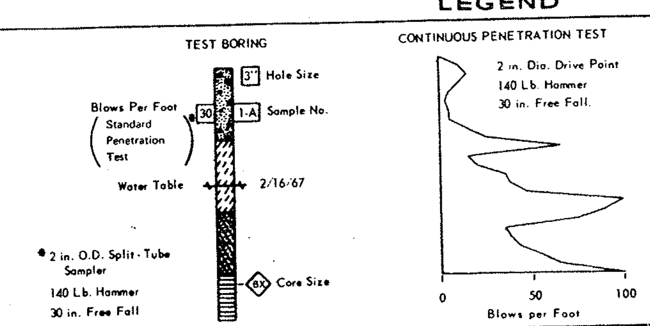
SUMMARY OF TEST RESULTS

Sample No.	Depth	Classification: Corps of Engrs. or Visual	Classification: AASHO	Grading Analysis (Percent): Gravel	Coarse Sand	Fine Sand	Silt and Clay	Atterberg Limits: Liquid Limit L_w	Plastic Limit P_w	Plastic Index I_w	Water Cont. w %	Wet Unit Weight γ P.C.F.	Unconfined Strength Q_u T.S.F.	Triaxial Shear Strength: Unconsolidated ø°	C T.S.F.	Consolidated ø°	C T.S.F.	Time hrs.	Press P.S.I.	Dia. Of Sample (Inches)

TYPE OF MATERIAL

- SANDSTONE
- SILTY, CLAYEY SAND
- SILTY SAND & GRAVEL W/COBBLES & BOULDERS
- SILTY, CLAYEY SAND & GRAVEL
- SILTY SAND & GRAVEL W/COBBLES
- SAND & GRAVEL W/COBBLES & BOULDERS
- SILTY, CLAYEY SAND & GRAVEL W/COBBLES

LEGEND



- Location of Test Boring
- Location of Continuous Penetration Test
- Rotary Boring
- Auger Boring
- Core Boring

STRUCTURE NO. H-4-S
DWG. NO. B 3 OF 15

DIVISION OF HIGHWAYS STATE OF COLORADO

ENGINEERING GEOLOGY

Across PLATEAU CREEK
Sta.
Near MOLINA Sec. 16 T10 S R 96 W
Geologist E.C.C.
Made by D.L.S.
Checked by D.L.S.
Approved by Bridge Engineer
Date: 19

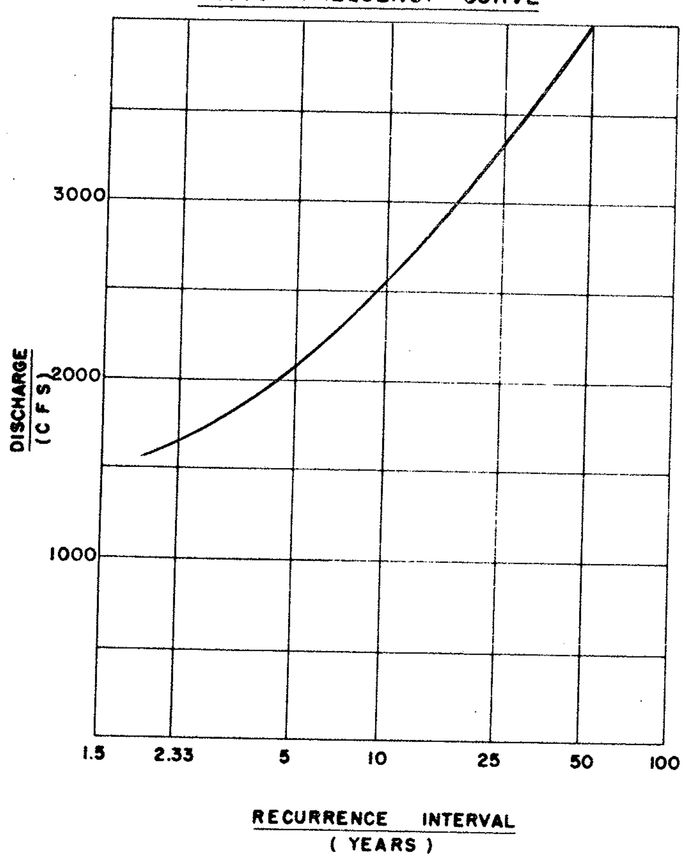
FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	BRS 0330(3)	12	60

AS CONSTRUCTED
NO REVISIONS DATE 1-4-75

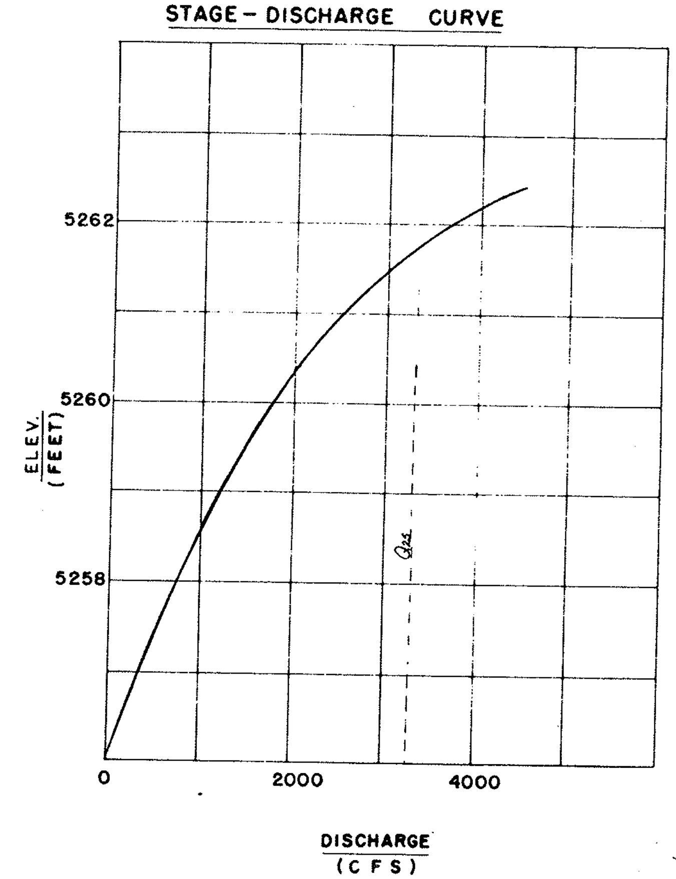
REVISIONS

BRIDGE HYDRAULIC INFORMATION

FLOOD FREQUENCY CURVE



STAGE - DISCHARGE CURVE



SUMMARIZED STREAM DATA

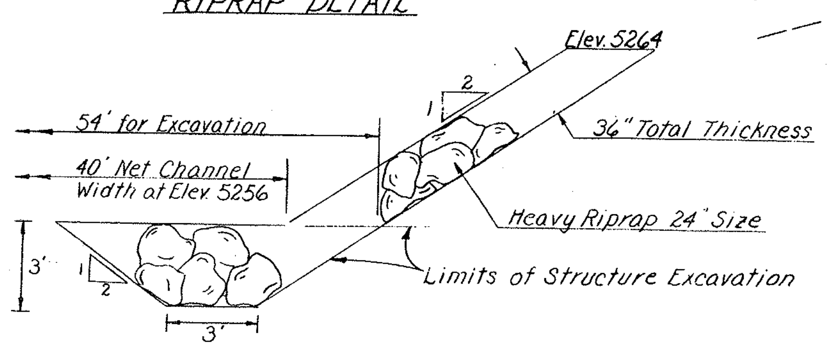
NATURAL (BEFORE NEW CONSTRUCTION)

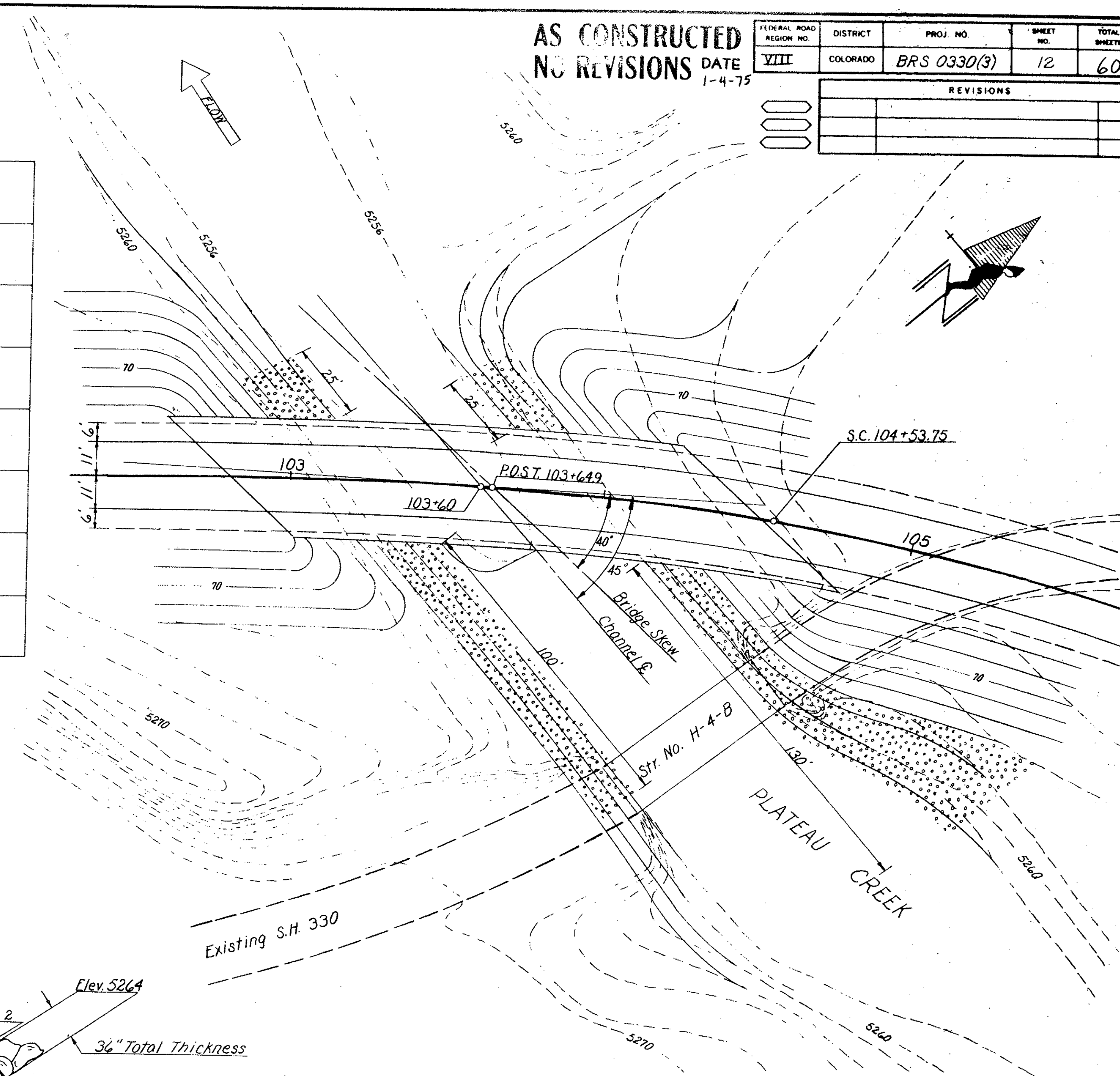
1. Drainage Area (or Water Right) 484 Sq. Mi
2. Average Slope of Streambed 0.013 Ft./Ft.
3. Description of Channel See No. 10
4. Stability of Channel: Stable ☒ Aggrading ☐ Degrading ☐
5. Drift: Insignificant ☒ Brush & Debris ☐ Large Trees & Logs ☐ Other
6. Ice: Yes ☐ No ☐ Unknown ☒
7. Streambed Elevation 5256.0
8. Design Flow Elevation ~5261.5
9. Maximum Velocity at Design Flow 9 FPS
10. Remarks Channel stable with gravel and cobbles in bottom. Overbank lined with brush, grass, and trees.

DESIGN (AFTER NEW CONSTRUCTION)

1. Design Frequency 25 Year
2. Design Discharge (or Water Right) 3300 CFS
3. Source of Design Discharge Analysis of USGS stream gages.
4. Water Surface Elevation at Upstream Edge of Structure ~5262.0
5. Maximum Backwater Increase Due To Structure 1.5 Ft.
6. Velocity Through Structure at Design Flow (Average) 11.0 FPS (Maximum) 12.5 FPS
7. Remarks:

RIPRAP DETAIL





Riprap
Existing Contours
Finish Contours

DIVISION OF HIGHWAYS

BRIDGE HYDRAULIC INFORMATION for PLATEAU CREEK

Approved: D. Roupp, Hydraulic Engineer	Designer: D. Hogan	Detailer:
	Structure Numbers	H-4-S
Date: APR. 15, 1974	DWG. No. B 4 of 15	

DESIGNED BY	CHECKED BY	DETAILED BY	INITIAL	DATE	CHECKED BY	QUANTITIES BY	CHECKED BY

	STATION	ELEVATION
ABUT 1 END OF WING		
WEST OUTSIDE	102 + 37.57	5276.77
EAST OUTSIDE	102 + 84.50	5275.82
ABUT 1 BACKFACE		
WEST OUT	102 + 61.34	5276.88
WEST INSIDE	102 + 62.60	5276.85
TAN AT POS	102 + 77.95	5276.50
CL OF BRIDGE	102 + 81.15	5276.41
EAST INSIDE	103 + .36	5275.78
EAST OUTSIDE	103 + 1.72	5275.73

CL BRG ABUT 1
CL SO BRG ABUT 1

	STATION	ELEVATION
WEST OUTSIDE		
STA BACK	102 + 63.82	5276.89
1 10TH	102 + 71.37	5276.94
2 10TH	102 + 78.96	5276.98
3 10TH	102 + 86.59	5277.03
4 10TH	102 + 94.24	5277.07
5 10TH	103 + 1.94	5277.12
6 10TH	103 + 9.68	5277.17
7 10TH	103 + 17.46	5277.21
8 10TH	103 + 25.28	5277.26
9 10TH	103 + 33.16	5277.31
STA AHEAD	103 + 41.08	5277.35
GIRDER 1		
STA BACK	102 + 66.37	5276.84
1 10TH	102 + 74.29	5276.87
2 10TH	102 + 82.20	5276.91
3 10TH	102 + 90.12	5276.94
4 10TH	102 + 98.03	5276.97
5 10TH	103 + 5.95	5277.00
6 10TH	103 + 13.86	5277.04
7 10TH	103 + 21.77	5277.07
8 10TH	103 + 29.67	5277.11
9 10TH	103 + 37.58	5277.15
STA AHEAD	103 + 45.48	5277.19
GIRDER 2		
STA BACK	102 + 74.96	5276.65
1 10TH	102 + 82.91	5276.66
2 10TH	102 + 90.87	5276.68
3 10TH	102 + 98.82	5276.69
4 10TH	103 + 6.78	5276.71
5 10TH	103 + 14.74	5276.72
6 10TH	103 + 22.69	5276.74
7 10TH	103 + 30.65	5276.76
8 10TH	103 + 38.60	5276.78
9 10TH	103 + 46.55	5276.81
STA AHEAD	103 + 54.50	5276.84
GIRDER 3		
STA BACK	102 + 83.62	5276.42
1 10TH	102 + 91.62	5276.41
2 10TH	102 + 99.62	5276.41
3 10TH	103 + 7.62	5276.41
4 10TH	103 + 15.62	5276.41
5 10TH	103 + 23.63	5276.41
6 10TH	103 + 31.63	5276.41
7 10TH	103 + 39.64	5276.41
8 10TH	103 + 47.64	5276.42
9 10TH	103 + 55.64	5276.43
STA AHEAD	103 + 63.64	5276.44
GIRDER 4		
STA BACK	102 + 92.38	5276.15
1 10TH	103 + .42	5276.13
2 10TH	103 + 8.47	5276.10
3 10TH	103 + 16.52	5276.09
4 10TH	103 + 24.57	5276.07
5 10TH	103 + 32.63	5276.05
6 10TH	103 + 40.68	5276.04
7 10TH	103 + 48.74	5276.03
8 10TH	103 + 56.80	5276.02
9 10TH	103 + 64.86	5276.01
STA AHEAD	103 + 72.91	5276.02
GIRDER 5		
STA BACK	103 + 1.24	5275.84
1 10TH	103 + 9.33	5275.80
2 10TH	103 + 17.43	5275.76
3 10TH	103 + 25.53	5275.72
4 10TH	103 + 33.64	5275.69
5 10TH	103 + 41.75	5275.66
6 10TH	103 + 49.86	5275.63
7 10TH	103 + 57.98	5275.60
8 10TH	103 + 66.09	5275.58
9 10TH	103 + 74.21	5275.56
STA AHEAD	103 + 82.33	5275.55
EAST OUTSIDE		
STA BACK	103 + 4.33	5275.72
1 10TH	103 + 12.29	5275.68
2 10TH	103 + 20.31	5275.64
3 10TH	103 + 28.39	5275.60
4 10TH	103 + 36.53	5275.56
5 10TH	103 + 44.74	5275.52
6 10TH	103 + 53.02	5275.48
7 10TH	103 + 61.38	5275.44
8 10TH	103 + 69.81	5275.40
9 10TH	103 + 78.33	5275.36
STA AHEAD	103 + 86.94	5275.31

STATE HIGHWAY NO. 330
OVER PLATEAU CREEK
STRUCTURE NO H-4-5
DESIGNED RRA 6-1-73
DETAILED AND INPUT RRA 7-5-73
ALL ELEVATIONS ARE 0.125
FEET BELOW FINISHED GRADE
ELEVATIONS

INPUT DATA FOR BRIDGE H-4-5

```
BT    =  101 +  3.7500 ALPHA = -43 10 52.00  NCON = -1000.0000  GBK  = -.4286
PI    =  106 +  0.0000    DC =   7  0  0.00  WCON =  1000.0000  GAM  =  .9750
POS   =  103 + 64.8800 THETA =  12 15  0.00    LS =    350  MAX   = .0730
CLOFF =    0.0000  EPI =  5274.8750   VC =    400  MIN   =  .0200
                TYPE = 1 PVOFF =  17.0000 STLPL =    0.0000
```

	STATION	ELEVATION
ABUT 3 BACKFACE		
WEST OUT	104 + 23.50	5277.85
WEST INSIDE	104 + 25.15	5277.78
TAN AT POS	104 + 45.32	5276.79
CL OF BRIDGE	104 + 49.97	5276.55
EAST INSIDE	104 + 77.07	5275.09
EAST OUTSIDE	104 + 79.05	5274.99

CL NO BRG PIER 2
CL BRG ABUT 3

	STATION	ELEVATION
WEST OUTSIDE		
STA BACK	103 + 44.08	5277.37
1 10TH	103 + 51.46	5277.42
2 10TH	103 + 58.89	5277.46
3 10TH	103 + 66.37	5277.50
4 10TH	103 + 73.92	5277.55
5 10TH	103 + 81.52	5277.59
6 10TH	103 + 89.20	5277.64
7 10TH	103 + 96.94	5277.69
8 10TH	104 + 4.75	5277.73
9 10TH	104 + 12.65	5277.78
STA AHEAD	104 + 20.63	5277.84
GIRDER 1		
STA BACK	103 + 47.14	5277.26
1 10TH	103 + 55.02	5277.28
2 10TH	103 + 62.90	5277.30
3 10TH	103 + 70.78	5277.32
4 10TH	103 + 78.66	5277.35
5 10TH	103 + 86.54	5277.38
6 10TH	103 + 94.42	5277.41
7 10TH	104 + 2.30	5277.44
8 10TH	104 + 10.18	5277.48
9 10TH	104 + 18.05	5277.53
STA AHEAD	104 + 25.91	5277.59
GIRDER 2		
STA BACK	103 + 56.93	5276.87
1 10TH	103 + 64.86	5276.87
2 10TH	103 + 72.80	5276.88
3 10TH	103 + 80.74	5276.89
4 10TH	103 + 88.69	5276.90
5 10TH	103 + 96.63	5276.91
6 10TH	104 + 4.57	5276.93
7 10TH	104 + 12.51	5276.96
8 10TH	104 + 20.45	5276.99
9 10TH	104 + 28.39	5277.03
STA AHEAD	104 + 36.31	5277.08
GIRDER 3		
STA BACK	103 + 66.86	5276.44
1 10TH	103 + 74.86	5276.43
2 10TH	103 + 82.86	5276.42
3 10TH	103 + 90.87	5276.41
4 10TH	103 + 98.88	5276.41
5 10TH	104 + 6.88	5276.41
6 10TH	104 + 14.89	5276.42
7 10TH	104 + 22.90	5276.44
8 10TH	104 + 30.90	5276.46
9 10TH	104 + 38.90	5276.50
STA AHEAD	104 + 46.90	5276.54
GIRDER 4		
STA BACK	103 + 76.95	5275.97
1 10TH	103 + 85.01	5275.94
2 10TH	103 + 93.08	5275.92
3 10TH	104 + 1.16	5275.90
4 10TH	104 + 9.24	5275.88
5 10TH	104 + 17.31	5275.88
6 10TH	104 + 25.39	5275.88
7 10TH	104 + 33.47	5275.89
8 10TH	104 + 41.54	5275.91
9 10TH	104 + 49.61	5275.93
STA AHEAD	104 + 57.67	5275.96
GIRDER 5		
STA BACK	103 + 87.20	5275.45
1 10TH	103 + 95.34	5275.41
2 10TH	104 + 3.48	5275.38
3 10TH	104 + 11.63	5275.35
4 10TH	104 + 19.78	5275.32
5 10TH	104 + 27.93	5275.31
6 10TH	104 + 36.08	5275.30
7 10TH	104 + 44.23	5275.30
8 10TH	104 + 52.37	5275.32
9 10TH	104 + 60.51	5275.34
STA AHEAD	104 + 68.64	5275.36
EAST OUTSIDE		
STA BACK	103 + 90.20	5275.30
1 10TH	103 + 98.26	5275.26
2 10TH	104 + 6.41	5275.22
3 10TH	104 + 14.66	5275.18
4 10TH	104 + 23.01	5275.14
5 10TH	104 + 31.48	5275.11
6 10TH	104 + 40.06	5275.08
7 10TH	104 + 48.77	5275.05
8 10TH	104 + 57.62	5275.03
9 10TH	104 + 66.61	5275.01
STA AHEAD	104 + 75.75	5274.99
ABUT 3 END OF WING		
WEST OUTSIDE	104 + 40.12	5277.97
EAST OUTSIDE	104 + 96.54	5274.96

FEDERAL ROAD REGION NO	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	BRS 0330(3)	13	60

REVISIONS

AS CONSTRUCTED
NO REVISIONS DATE 1-4-75

	INITIAL	DATE			
DESIGNED BY	RRA	4-73	CHECKED BY	BOE	8-73
CHECKED BY	J.H.	4-73	QUANTITIES BY	LS	8-73
DETAILED BY	L.S	9-73	CHECKED BY	BOE	8-73

DIVISION OF HIGHWAYS

ELEVATIONS

Approved:

Bridge Engineer
Date:

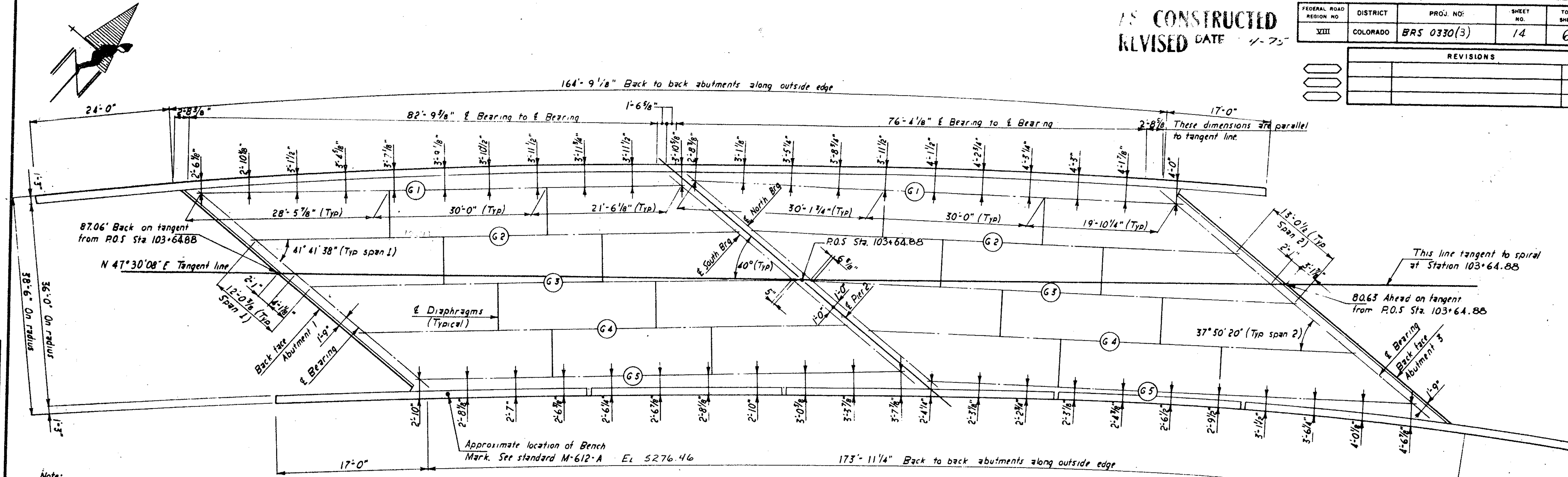
Designer: R Akin
Detailer: L. Sims
Structure Numbers: H-4-5

DWG. No. B 5 OF 15

AS CONSTRUCTED
REVISED DATE 4-75

FEDERAL ROAD REGION NO	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	BRS 0330(3)	14	60

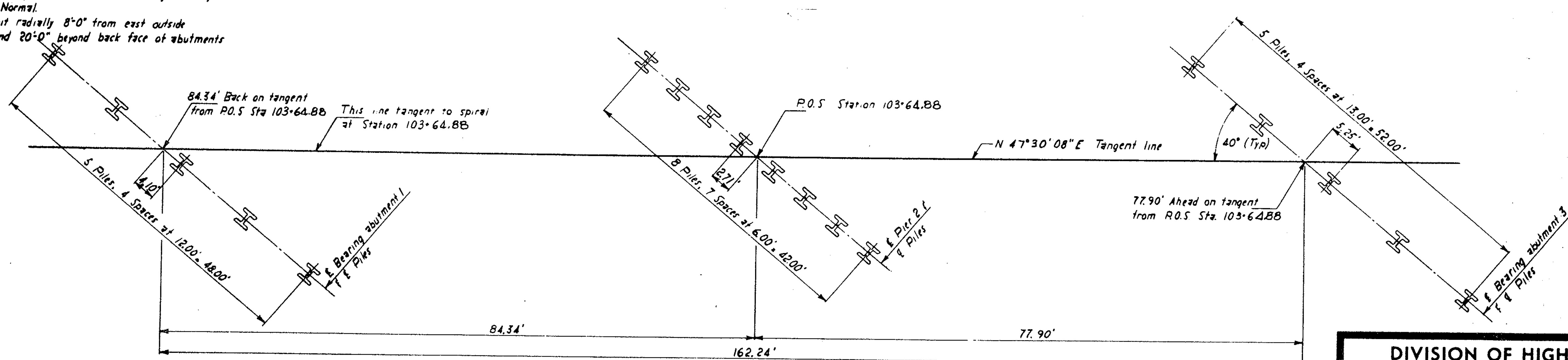
REVISIONS



Note:
All curb offsets are spaced at 10 th points of the span lengths
For Bridge Rail Type 3 details see DWG. No B 13
Two 1'-0" curb cuts each span low side only, third points
(Cut interfering reinforcing and place to avoid Bridge Posts)
Girder spacing 8'-0" Normal.
Place Telephone Conduit radially 8'-0" from east outside edge of deck and extend 20'-0" beyond back face of abutments

CONSTRUCTION LAYOUT

	INITIAL	DATE			
DESIGNED BY	RRA	6-73	CHECKED BY	B.D.E.	8-73
CHECKED BY	J.H.	8-73	QUANTITIES BY	L.S.	8-73
DETAILED BY	R.J.S.	7-73	CHECKED BY	B.E.	8-73



PILING LAYOUT

Notes:
The piling dimensions shown are at the bottom of the concrete
All piling to be HP 12 x 74 with a maximum pile load of 86 tons at abutment 1, 89 tons at pier 2 and 92 tons at abutment 3

DIVISION OF HIGHWAYS

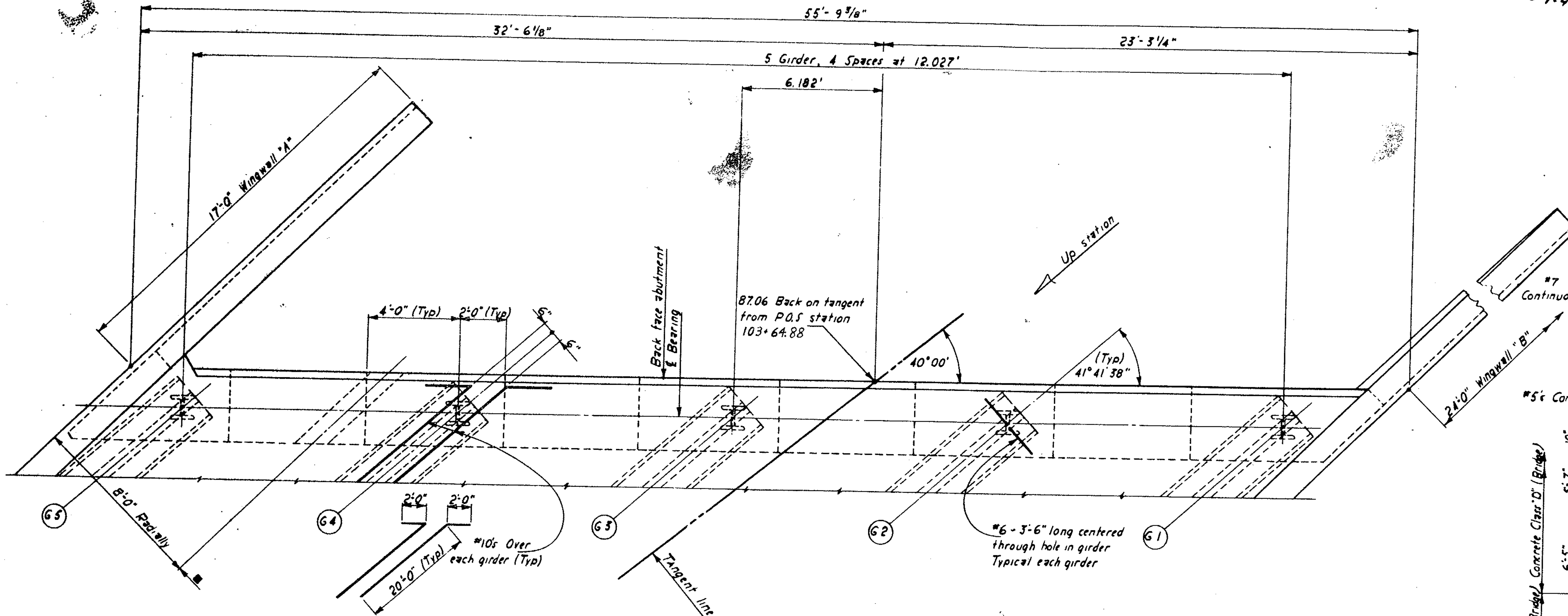
CONSTRUCTION AND PILING LAYOUTS

Designer R Akin
Detailer R Seylhouwer
Structure Numbers H-4-S
Drawing Number B 6 of 15 Drawings

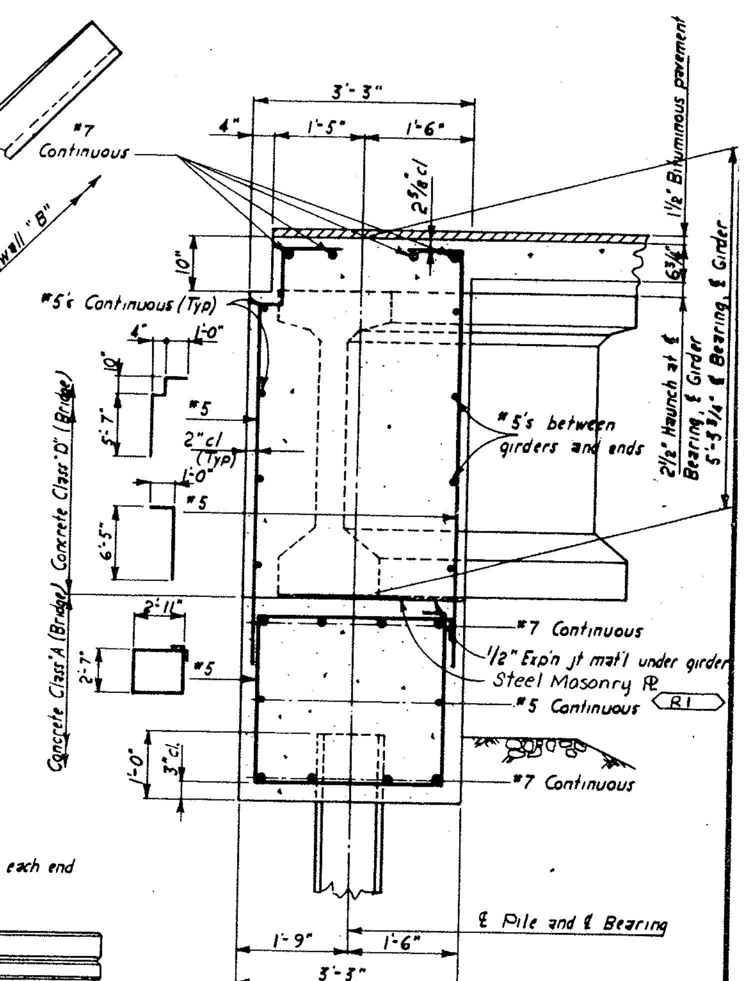
AS CONSTRUCTED
NO REVISIONS DATE 1-4-75

FEDERAL ROAD REGION NO	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	BRS 0330 (3)	15	60

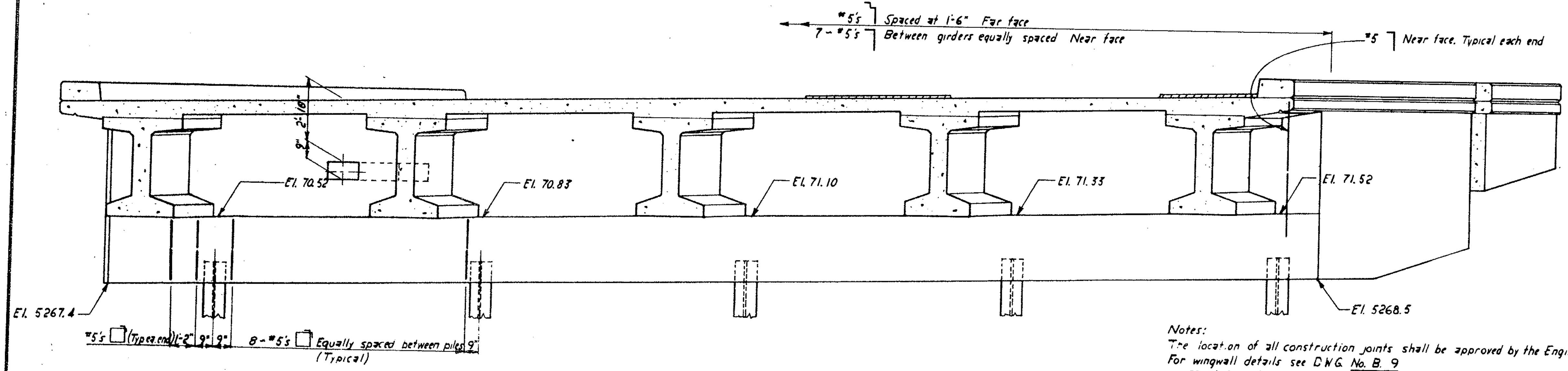
REVISIONS			
R1	6-27-74	Replaced Elastomeric Pads with Steel Pls I/A/W C.O. # 05765	RRA



Plan ~ Abutment 1



Typical Section Thru Abutment



Elevation ~ Abutment 1

For additional reinforcing steel details see Typical Section Thru Abutment

Notes:
The location of all construction joints shall be approved by the Engineer.
For wingwall details see DWG. No. B. 9
■ 9" x 1'-0" Void through abutment to accommodate Telephone conduit, move interferring reinforcing

	INITIAL	DATE			
DESIGNED BY	RRA	6-73	CHECKED BY	B.D.E.	8-73
CHECKED BY	J.H.	8-73	QUANTITIES BY	L.S.	8-73
DETAILED BY	RJS	7-24-73	CHECKED BY	B.E.	8-73

DIVISION OF HIGHWAYS

Details Abutment 1

Designer R. Akin		Structure Numbers	H-4-S
Detailer R. Seylhouwer			
Drawing Number B 7		of 15	Drawings

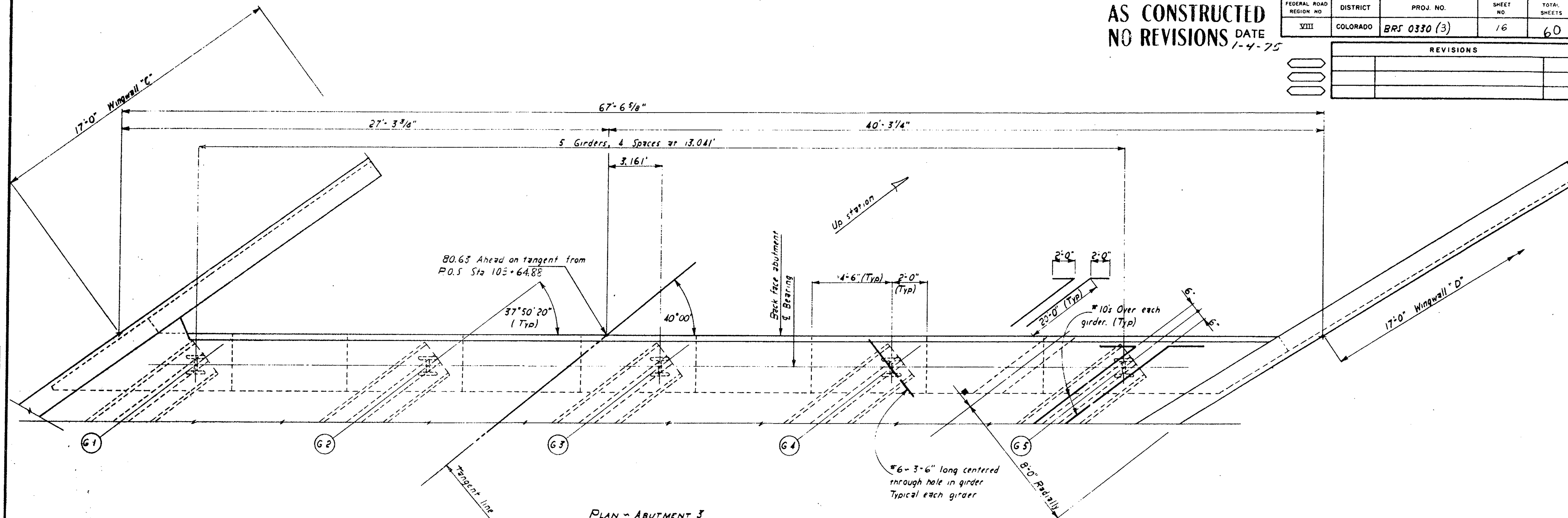
DIVISION OF HIGHWAYS—STATE OF COLORADO

AS CONSTRUCTED
NO REVISIONS DATE 1-4-75

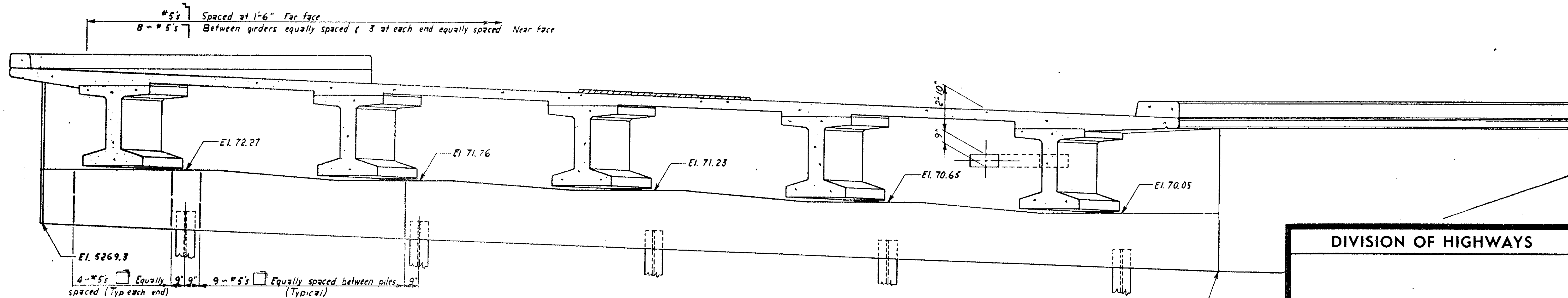
FEDERAL ROAD REGION NO	DISTRICT	PROJ. NO.	SHEET NO	TOTAL SHEETS
VIII	COLORADO	BRS 0330 (3)	16	60

REVISIONS

	INITIAL	DATE			
DESIGNED BY	RRA	6-73	CHECKED BY	B.E.	8-73
CHECKED BY	J.H.	8-73	QUANTITIES BY	L.S.	8-73
DETAILED BY	RJS	7-25-73	CHECKED BY	B.E.	8-73



PLAN ~ ABUTMENT 3



ELEVATION ~ ABUTMENT 3

For additional reinforcing steel details see Typical Section thru Abutment
See DWG No. B 7

Notes:
The location of all construction joints shall be approved by the Engineer
For wingwall details see DWG No. B 9
■ 9" x 1'-0" Void through abutment to accommodate Telephone conduit, move interfering reinforcing

DIVISION OF HIGHWAYS

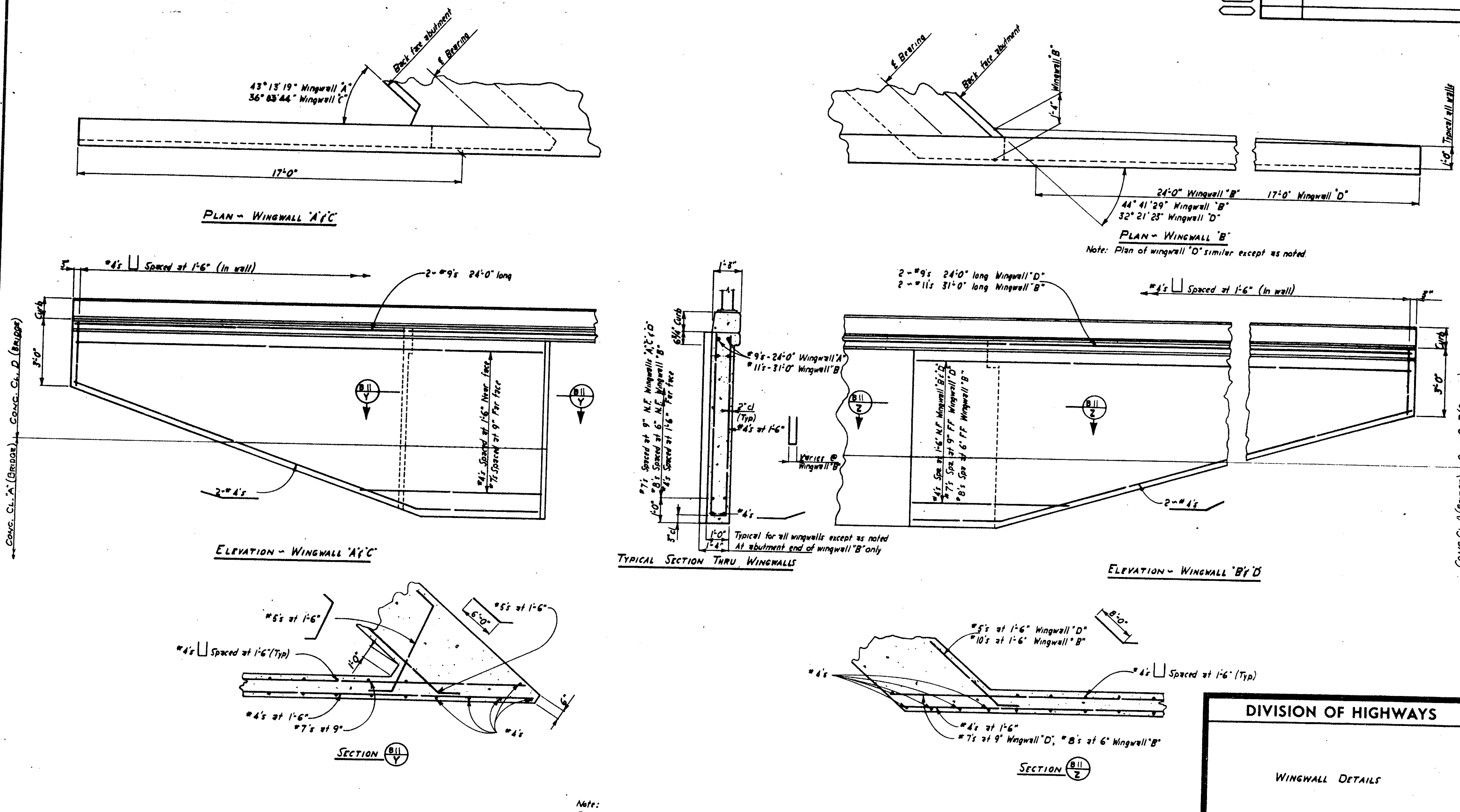
DETAILS ABUTMENT 3

Designer	R Akin	Structure Numbers	H-4-S
Detailer	R Seylhouwer		
Drawing Number B 8		of 15	Drawings

AS CONSTRUCTED
NO REVISIONS DATE 1-4-75

FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	BRS 0330(3)	17	60

REVISIONS



Note:
For curb details and reinforcing see Bridge Rail Type 3 DWG. No B 13

	INITIAL	DATE		
DESIGNED BY	R.P.A.	6-73	CHECKED BY	B.D.E. 8-73
CHECKED BY	J.H.	8-73	QUANTITIES BY	J.S. 8-73
DETAILED BY	R.J.S.	7-73	CHECKED BY	B.E. 8-73

DIVISION OF HIGHWAYS

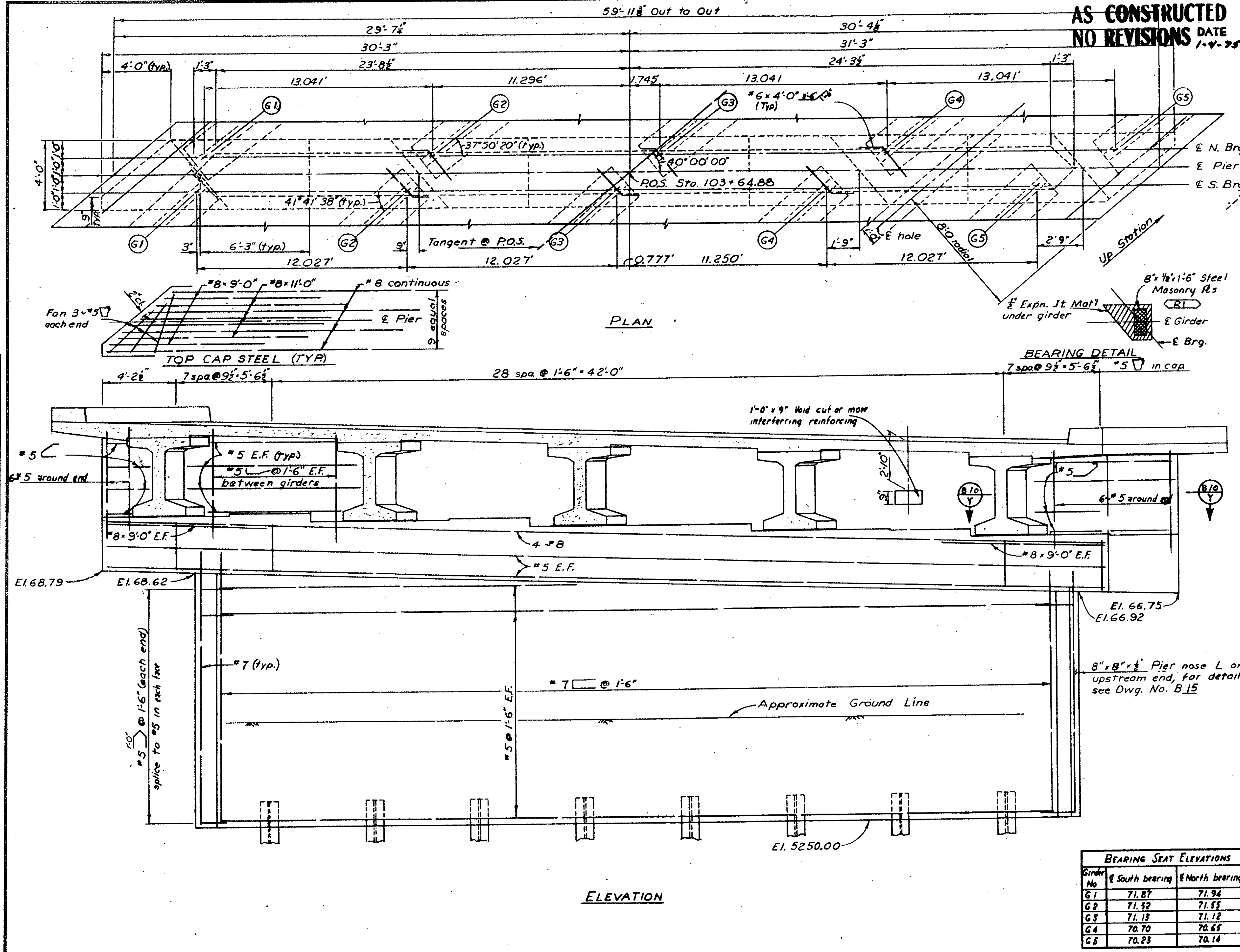
WINGWALL DETAILS

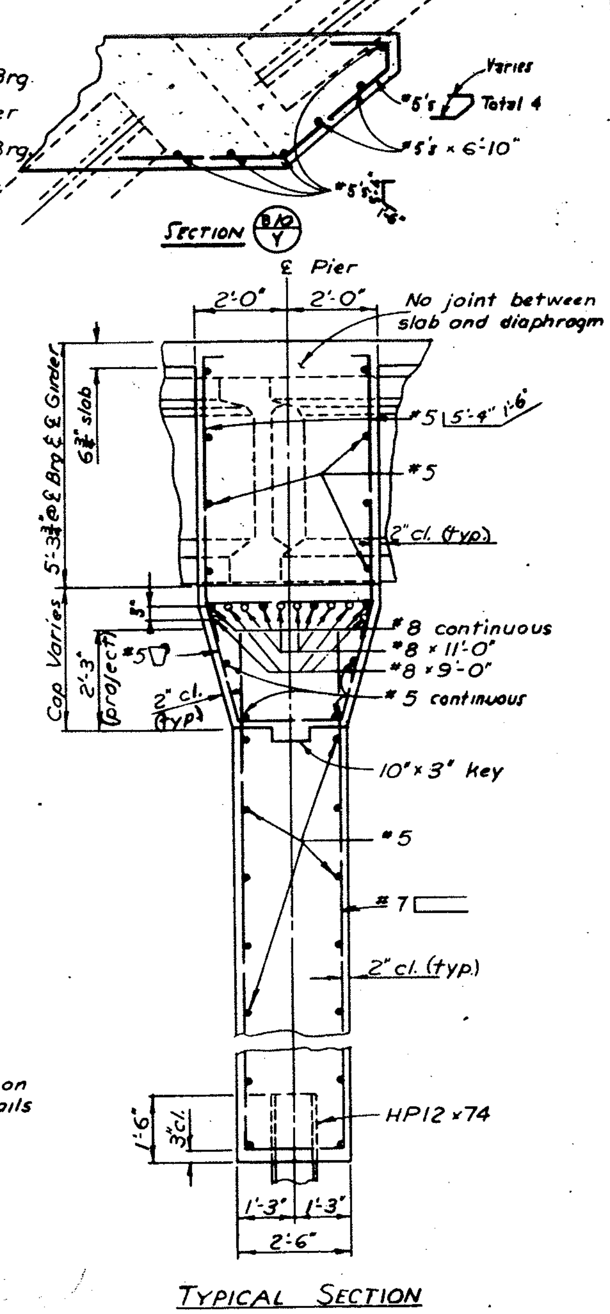
Designer	R. Akin	Structure Numbers	H-4-S
Detailer	R. Seylhouwer		
Drawing Number B 9		of 15	Drawings

AS CONSTRUCTED
NO REVISIONS DATE 1-4-75

FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	BR 50330(3)	18	60

REVISIONS			
R1	6-27-74	Replaced Elastomeric Pads with Steel Pls I/A/W C.O. # 05765	RRA





BEARING SEAT ELEVATIONS		
Girder No	℄ South bearing	℄ North bearing
G1	71.87	71.94
G2	71.52	71.55
G3	71.13	71.12
G4	70.70	70.65
G5	70.23	70.14

INITIAL	DATE		
DESIGNED BY RRA	6-73	CHECKED BY B.D.E.	8-73
CHECKED BY J.H.	8-73	QUANTITIES BY L.S.	8-73
DETAILED BY EHH	7-73	CHECKED BY B.E.	8-73

DIVISION OF HIGHWAYS

PIER 2 DETAILS

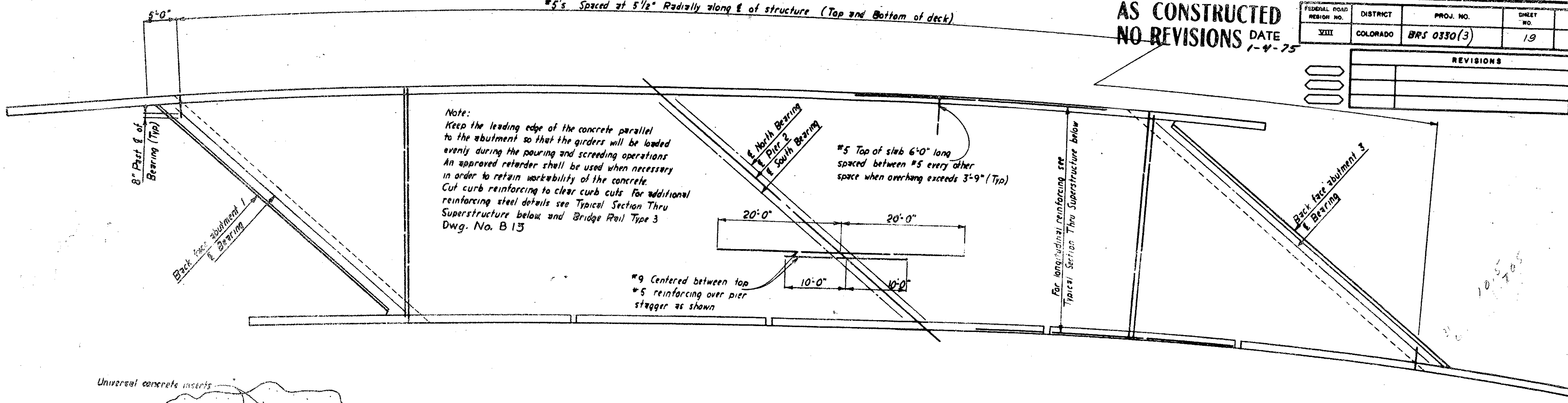
Designer R. Akin
Detailer E. Hadley
Structure Numbers H-4-S
Drawing Number B 10 of 15 Drawings

AS CONSTRUCTED
NO REVISIONS DATE 1-4-75

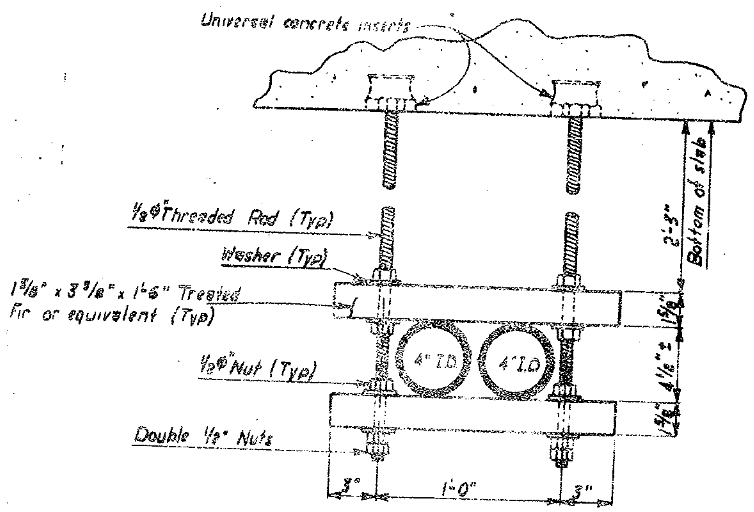
FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	BRS 0330(3)	19	60

REVISIONS

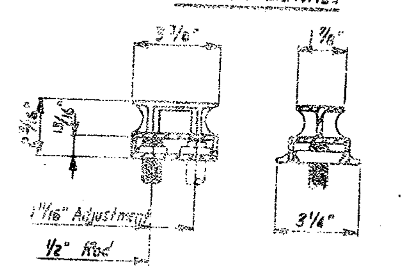
DESIGNED BY	R.R.A.	6-73
CHECKED BY	J.H.	8-73
DETAILED BY	R.T.S.	7-19-73
CHECKED BY	B.D.E.	8-73
QUANTITIES BY	L.S.	8-73
CHECKED BY	B.E.	8-73



Superstructure Reinforcing

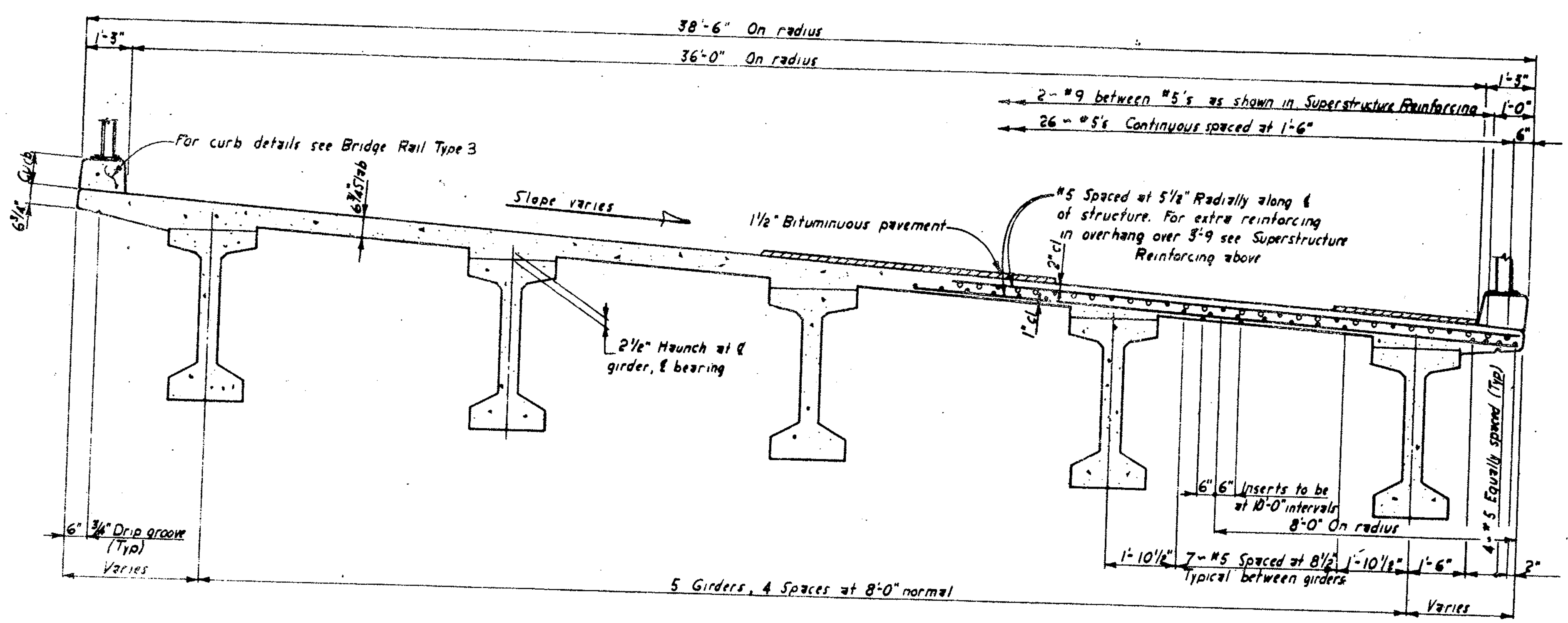


Hanger Details



Universal Concrete Insert

Note:
All work and material required to accomplish the above shall be included in the bid for item 613. Conduit to be furnished by others



Typical Section Thru Superstructure
Looking up station

DIVISION OF HIGHWAYS

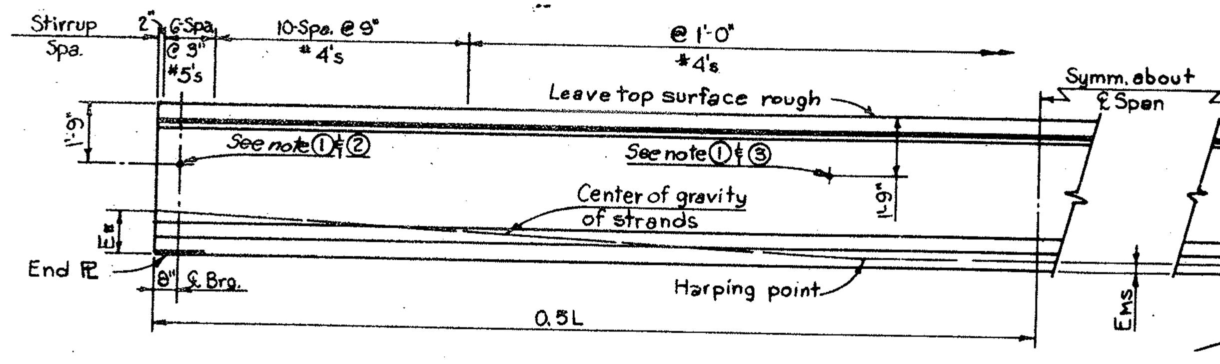
Superstructure Details

Designer	R. Akin	Structure Numbers	H-4-S
Detailer	R. Seylhouwer		
Drawing Number B 11		of	15 Drawings

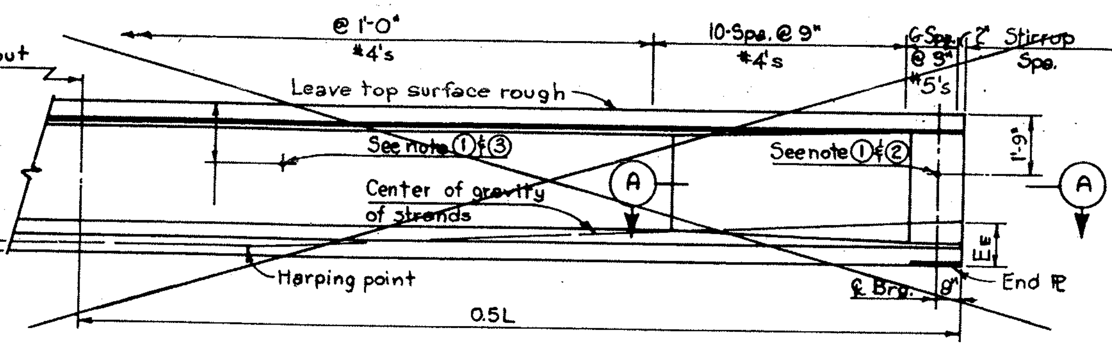
AS CONSTRUCTED
NO REVISIONS DATE 1-4-75

FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	BRS 0330(3)	20	60

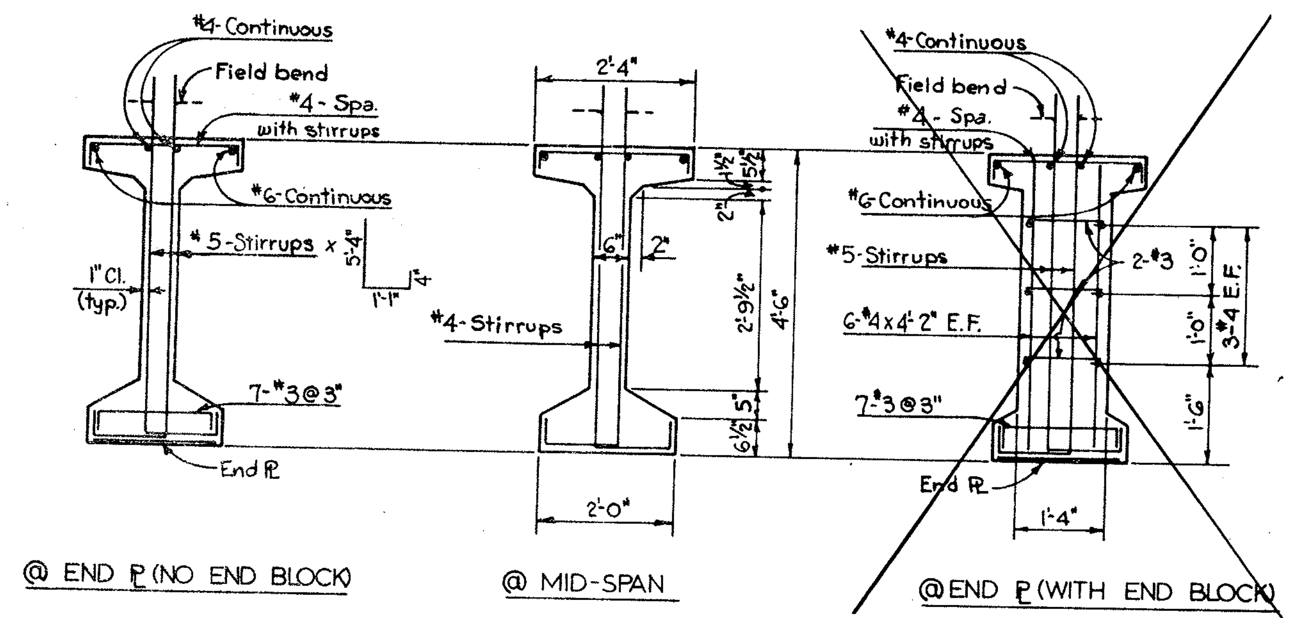
REVISIONS			
R1	6-27-74	Replaced Elastomeric Pads with	
		Steel Pls I/A/W C.o.# 05765	RRA



GIRDER ELEVATION (NO END BLOCK)



~~GIRDER ELEVATION (WITH END BLOCK)~~

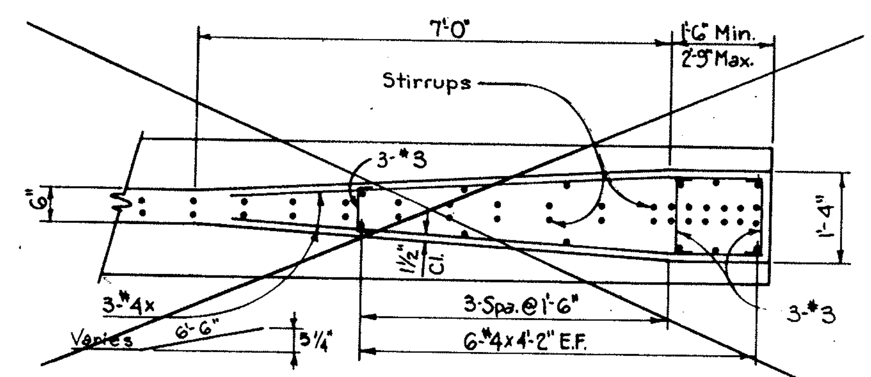


@ END Pl (NO END BLOCK)

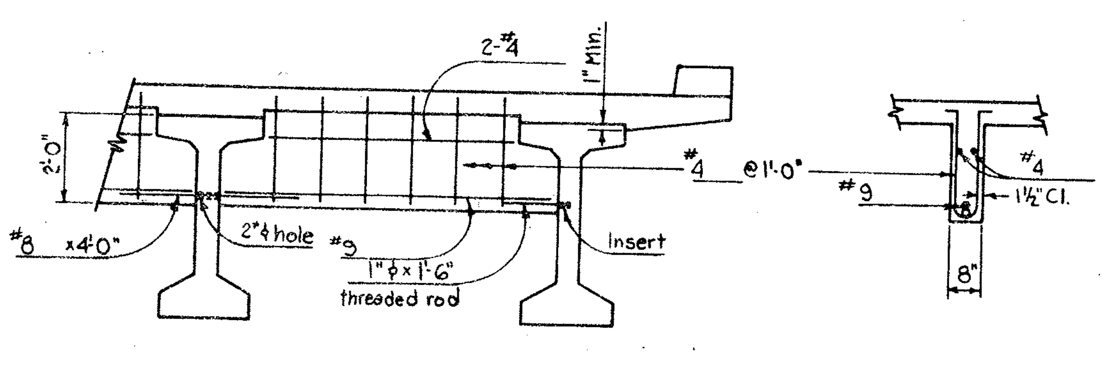
@ MID-SPAN

~~@ END Pl (WITH END BLOCK)~~

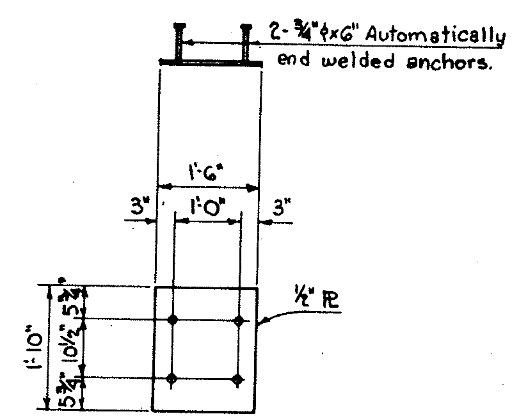
TYPICAL GIRDER SECTIONS



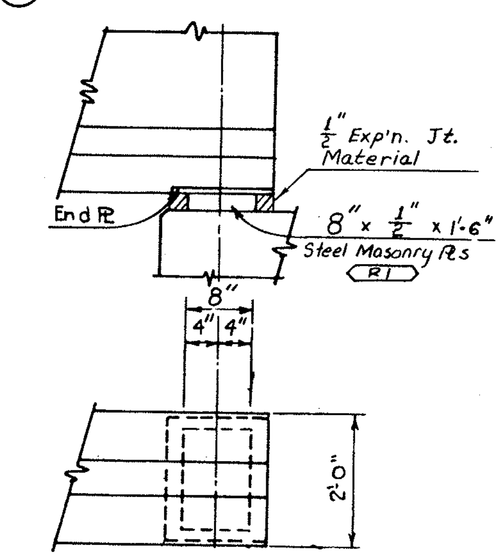
SECTION A



INTERMEDIATE DIAPHRAGM DETAILS



END Pl DETAIL



BEARING DETAIL

GENERAL NOTES

FABRICATION AND TOLERANCES OF THE PRESTRESSED GIRDERS AND BEARINGS SHALL CONFORM TO THE DIVISION OF HIGHWAYS, STATE OF COLORADO "STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION", "THE LATEST EDITION OF A.A.S.H.O. SPECIFICATIONS", AS AMENDED, AND "STANDARDS FOR PRESTRESSED CONCRETE POLES, SLABS, I-BEAMS AND BOX BEAMS FOR BRIDGES" AS PREPARED BY THE JOINT COMMITTEE OF THE A.A.S.H.O. COMMITTEE ON STRUCTURES AND THE P.C.I.

R1 ALL WORK NECESSARY TO FABRICATE AND INSTALL THE INTEGRAL PARTS OF THE GIRDER (INCLUDING THE 1" ø X 1'-6" THREADED RODS AND STEEL MASONRY PLS.) AS SHOWN ON THE PLANS SHALL BE INCLUDED IN THE BID PRICE FOR ITEM NO. 618, PRESTRESSED CONCRETE UNIT.

ALL ANCHOR BOLTS SHALL BE SNUGGED AND JAMMED EXCEPT AT EXPANSION BEARINGS WHERE THEY SHALL BE SNUGGED AND BACKED OFF ONE FULL TURN BEFORE JAMMING.

A MINIMUM OF TWO HARPING POINTS SHALL BE USED PER GIRDER.

CUT ALL STRANDS FLUSH WITH GIRDER ENDS. THE EXPOSED ENDS OF STRANDS AND A 1" STRIP OF ADJOINING CONCRETE SHALL BE CLEANED AND PAINTED WITH AN APPROVED WATERPROOFING COMPOUND.

USE 1/2" ø STRANDS f's = 270 KSI (STRESS-RELIEVED). ALTERNATE STRANDS ARE LOW-RELAXATION STRANDS MEETING THE REQUIREMENTS OF ASTM-A416-68 GRADE 270.

IF LOW-RELAXATION STRANDS ARE USED THE NET COMPRESSIVE STRESS IN THE CONCRETE AFTER ALL LOSSES SHALL BE AT LEAST AS LARGE AS THAT PROVIDED BY THE STRESS-RELIEVED STRANDS. ALSO, THE ULTIMATE STRENGTH OF THE STRUCTURE WITH THE LOW-RELAXATION STRANDS SHALL MEET THE REQUIREMENTS OF THE APPLICABLE A.A.S.H.O. SPECIFICATIONS.

INTITIAL PRESTRESS FORCE: THE JACKING FORCE PER GIRDER INCLUDING ALL LOSSES.
$F_i = f'_s \times 0.74 \times (A^*_s)$

FINAL PRESTRESS FORCE: THE FORCE REMAINING PER GIRDER AFTER ALL LOSSES
$F_f = f'_s \times 0.52 \times (A^*_s)$

A^*_s = AREA OF PRESTRESSING STEEL

f'_s = ULTIMATE STRENGTH OF PRESTRESSING STEEL

CONCRETE STRENGTH: F'_{ci} IS AT TIME OF RELEASE OF PRESTRESS FORCE. F'_c IS AT 28 DAYS.

CLEARANCE:
1. THE MINIMUM DISTANCE BETWEEN GROUPS OR INDIVIDUAL STRANDS IS 1 3/4" (MEASURED BETWEEN CENTERS OF ADJACENT STRANDS).
2. MINIMUM CONCRETE COVER FOR PRESTRESSING STEEL IS 1-1/2".

USE 1/2" MINIMUM CHAMFER ON ALL CORNERS.

① FOR DIAPHRAGM LOCATION, SEE SUPERSTRUCTURE PLAN.
② AT END DIAPHRAGMS, 2" DIAMETER HOLES.

③ AT INTERIOR DIAPHRAGMS, 2" DIAMETER HOLES EXCEPT AT EXTERIOR GIRDERS AND BRIDGES OTHER THAN 90° SKEW, OMIT HOLES AND PLACE INSERTS FOR 1" DIAMETER THREADED RODS.
④ DEFLECTION AT CENTER LINE OF SPAN DUE TO CAST IN PLACE SLAB.

GIRDER SCHEDULE

Span No.	Gird. No.	L (Feet)	Ems (Inch)	Ee (Inch)	Fi (KIPS)	Ff (KIPS)	Conc. strength F'_{ci} (PSI)	Conc. strength F'_c (PSI)	See Note ④ (Inch)
ALL	ALL	81'-4"	3 1/2	14	796	561	4000	4000	0.73

DIVISION OF HIGHWAYS

COLORADO G54 GIRDER

Designer R. AKIN		Structure Numbers	H-4-5
Detailer K. HEATER			
Drawing Number B 12	of 15 Drawings		

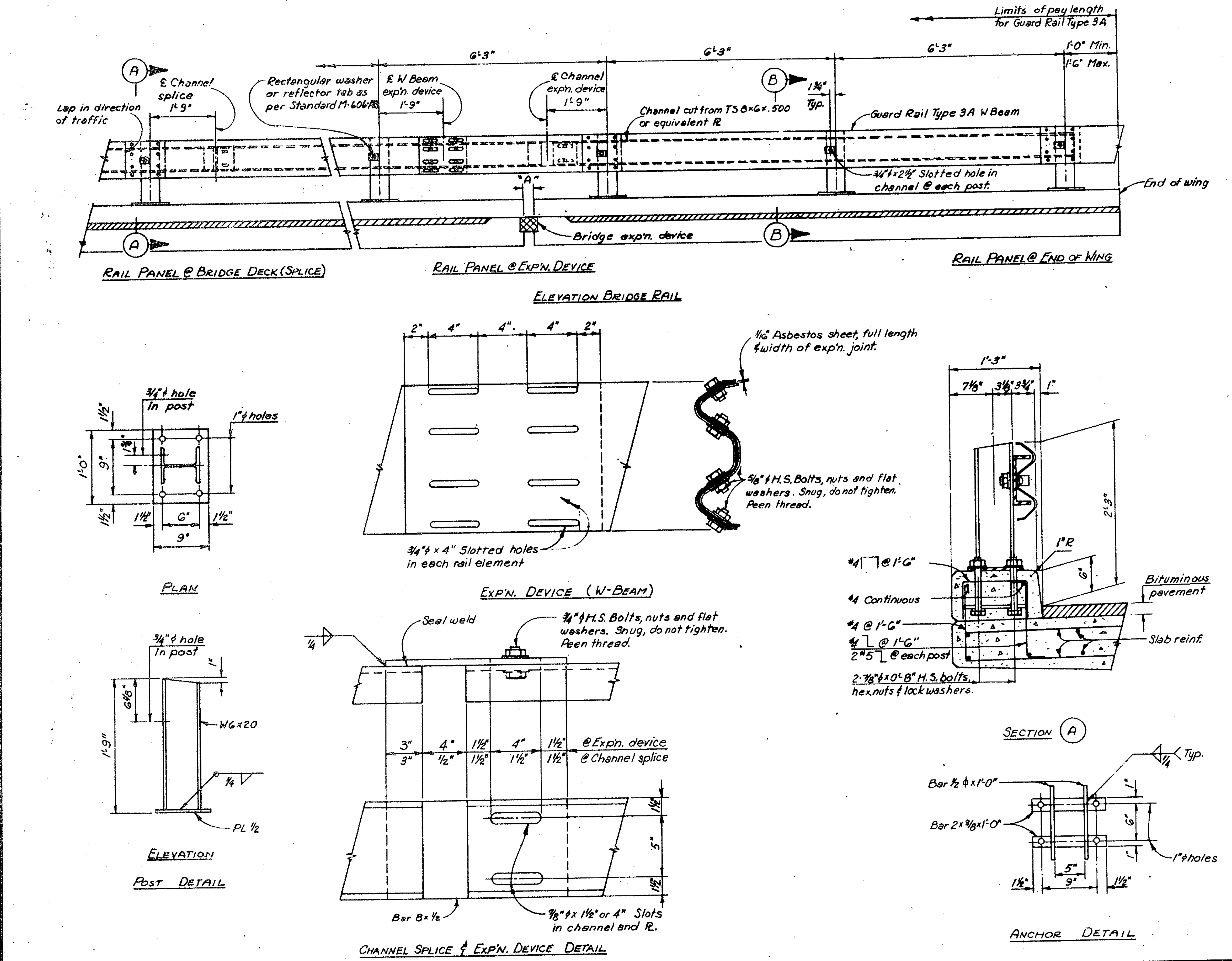
53(3-1-73)

STATE DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS—STATE OF COLORADO

AS CONSTRUCTED
NO REVISIONS DATE 1-4-75

FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	BRS 0330(3)	21	60

REVISIONS



NOTES

POSTS SHALL BE PERPENDICULAR TO THE GRADE OF THE DECK.

ALL POSTS, CHANNEL, CHANNEL SPLICE, EXPANSION DEVICE, ANCHOR ASSEMBLY, BOLTS, NUTS AND WASHERS SHALL BE GALVANIZED AFTER FABRICATION IN ACCORDANCE WITH THE SPECIFICATIONS AND SHALL BE MEASURED AND PAID FOR IN ACCORDANCE WITH SECTION 509.

CHANNEL SHALL BE CONTINUOUS OVER NOT LESS THAN TWO (2) POSTS.

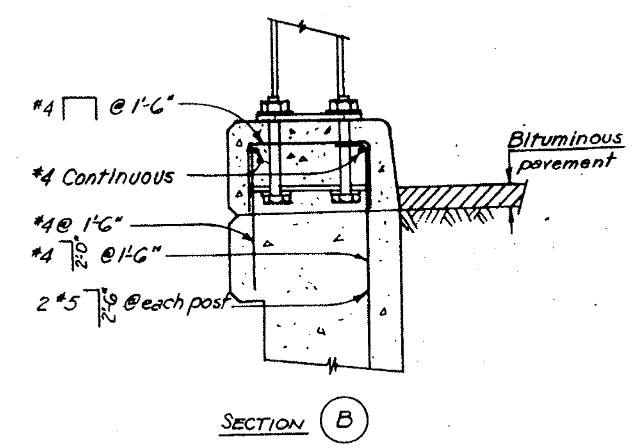
POSTS AT EXPANSION JOINT SHALL BE 1'-9" MINIMUM FROM THE CENTER LINE OF THE JOINT TO CENTER LINE OF POST MEASURED ALONG THE CENTER LINE OF POSTS.

ONE OR MORE 6'-3" PANELS MAY BE REDUCED (5'-0" MIN.) IN ORDER TO MAINTAIN DIMENSIONS FROM THE END OF WINGS AND EXPANSION JOINTS.

ALL EXPOSED CORNERS SHALL BE GROUND SMOOTH.

SEE STANDARD M-606-AB FOR ADDITIONAL DETAILS.

The 2'-0" offset between normal edge of shoulder Paving and face of Guard Rail as shown on std. M-606-AB is reduced to 1'-0" for this project.



	DATE	CHECKED BY	
DESIGNED BY P.K.P.	4-73	B.D.E.	8-73
CHECKED BY J.H.	8-73	QUANTITIES BY L.S.	8-73
DETAILED BY J.E.E.	12-73	CHECKED BY B.D.E.	8-73

DIVISION OF HIGHWAYS

BRIDGE RAIL TYPE 3

Designer	P.K. PADHIAR	Structure Numbers	H-4-S
Detailer	J.R. EWERT		
Drawing Number B	13	of 15	Drawings

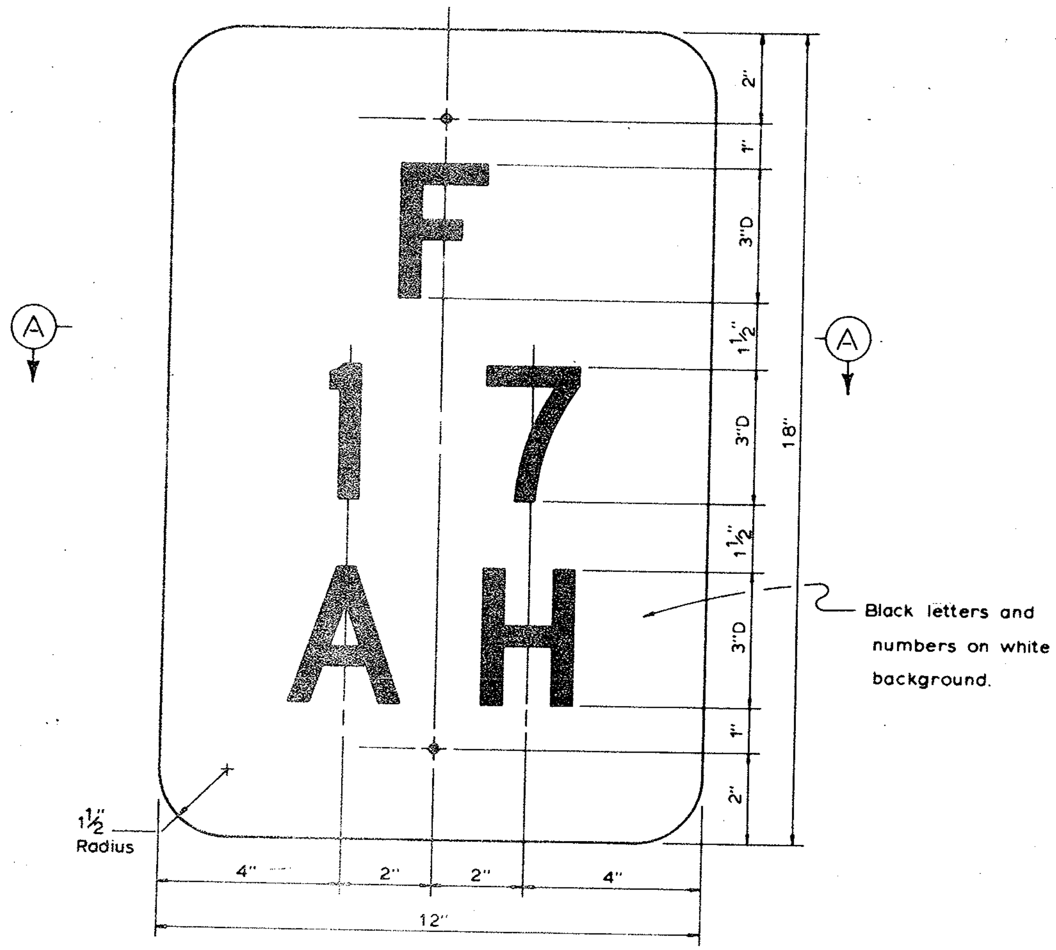
13(12-18-73)

AS CONSTRUCTED
NO REVISIONS DATE 1-4-75

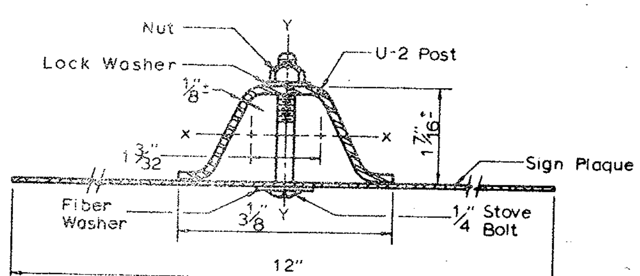
FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	BRS 0330(3)	23	60

REVISIONS

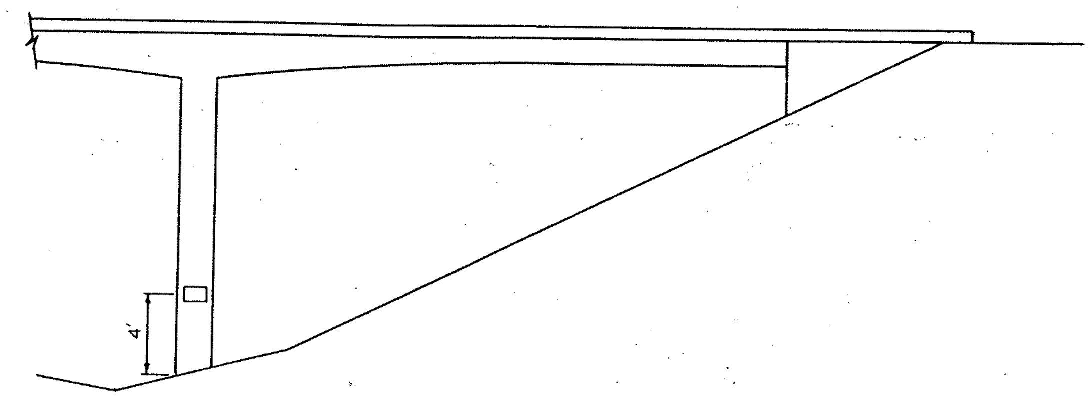
	INITIAL	DATE	CHECKED BY	
DESIGNED BY	RHA	4-73	CHECKED BY	L.S. 8-73
CHECKED BY	J.H.	6-73	QUANTITIES BY	
DETAILED BY	BRL	1-72	CHECKED BY	B.E. 6-73



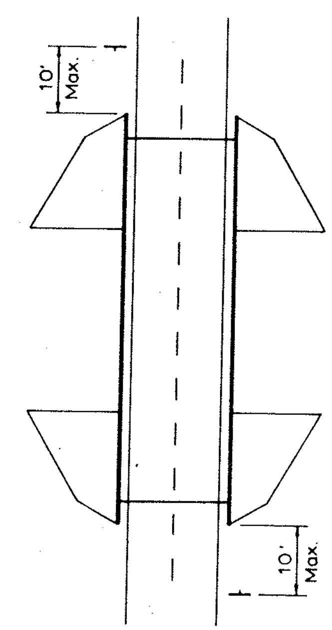
STRUCTURE IDENTIFICATION PANEL
(SAMPLE NUMBERS & LETTERS)



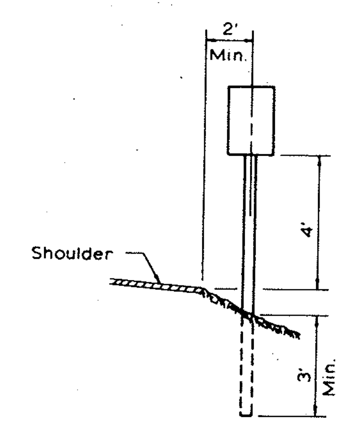
SECTION (A)



STRUCTURE NUMBER LOCATION ON PIERS



(1) STANDARD LOCATION DETAIL



U-2 POST IN GROUND

ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS APPLICABLE TO THE PROJECT.

SIGN PANEL SHALL BE FABRICATED FROM EITHER SHEET STEEL 0.0598 MIN. THICKNESS OR SHEET ALUMINUM 0.060 MIN. THICKNESS.

SIGN PANEL SHALL BE GROUND MOUNTED.

U-2 POST SHALL MEET REQUIREMENTS OF PAR. 4.3 U.S. DEPT. OF COMMERCE, COMMERCIAL STANDARD 184-51. ACCEPTABLE MATERIAL INCLUDES REROLLED RAILROAD RAILS. U-2 POST SHALL WEIGH 2 LBS. PER FT. EXCEPT THAT A MILL TOLERANCE OF MINUS 3-1/2% OF THE WEIGHT OF ANY ONE POST WILL BE ALLOWED. ALTERNATE METAL POST WILL BE ACCEPTABLE IF SECTION MODULUS IS AT LEAST 0.200 IN.^{3} ABOUT THE X-X AXIS AND AT LEAST 0.250 IN.^{3} ABOUT THE Y-Y AXIS.

SIGN PANEL SHALL BE FASTENED DIRECTLY TO THE POST WITH TWO 1/4" GALVANIZED OR CADMIUM PLATED STOVE BOLTS. A PLASTIC FIBER WASHER SHALL BE PLACED BETWEEN THE BOLTS HEAD AND THE FACE OF THE PANEL. A GALVANIZED OR CADMIUM PLATED LOCK WASHER SHALL BE PLACED UNDER THE NUT ON THE BACK OF THE POST. EXPOSED BOLT HEADS AND FIBER WASHERS ON THE FACE OF THE SIGN PANEL SHALL BE PAINTED TO MATCH THE SURROUNDING COLOR.

LETTERS AND NUMBERS SHALL BE SERIES "D". THEY SHALL BE 3" HIGH.

THE CORRECT STRUCTURE NUMBER IS SHOWN ON THE PLANS.

(1) OMIT STRUCTURE NUMBER STANDARDS WHERE A RAILROAD TRACK CROSSES OVER THE ROADWAY.

STRUCTURE NUMBER STANDARD SHALL NOT BE PAID FOR SEPARATELY BUT INCLUDED IN THE WORK.

IN ADDITION TO THE REQUIREMENTS STATED ABOVE, STRUCTURE NUMBERS FOR HIGHWAYS PASSING UNDER CROSSROADS ARE TO BE PLACED AT THE FOLLOWING POINTS:

(A) FOR STRUCTURES OF THREE OR MORE SPANS, THE STRUCTURE NUMBER SHALL BE STENCILED, FACING TRAFFIC, ON THE OUTSIDE FACE OF THE END COLUMN OF THE RIGHT HAND PIER.

(B) FOR TWO SPAN STRUCTURES, THE STRUCTURE NUMBER SHALL BE STENCILED, FACING TRAFFIC, ON THE OUTSIDE FACE OF EACH END COLUMN OF THE CENTER PIER.

DIVISION OF HIGHWAYS

STRUCTURE NUMBER STANDARD

Designer	R. AKIN	Structure Numbers	H-4-S
Detailer	L. Sims		
Drawing Number B 15		of 15	Drawings

70(2-1-72)

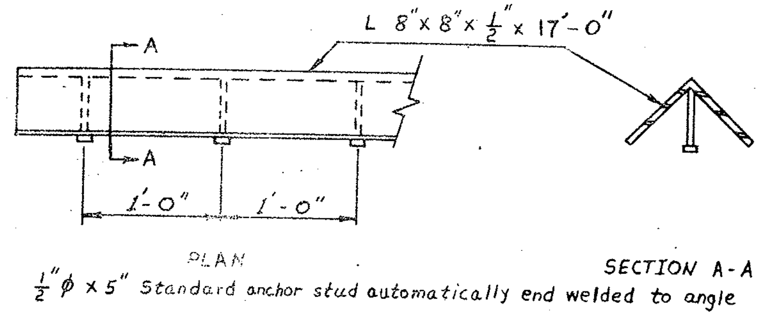
STATE DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS—STATE OF COLORADO
REV. DEC. 1972

	INITIAL	DATE			
DESIGNED BY	RRA	4-73	CHECKED BY		
CHECKED BY	J.H.	8-73	QUANTITIES BY	J.S.	8-73
DETAILED BY			CHECKED BY	B.E.	8-73

AS CONSTRUCTED
NO REVISIONS DATE 1-4-75

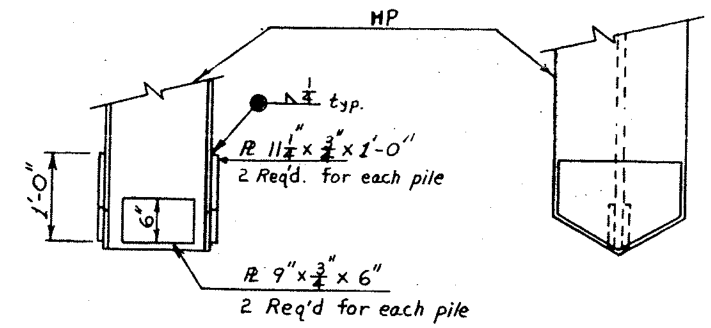
FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	BRS 0330(3)	22	60

REVISIONS

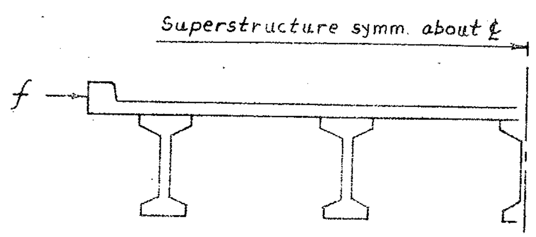


½" ϕ x 5" Standard anchor stud automatically end welded to angle

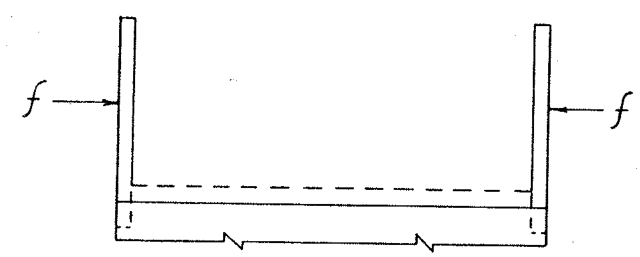
PIER NOSE ANGLE DETAIL



PILE TIP DETAILS



Superstructure



Abutments

CLASS 2 SURFACE FINISH DETAILS

DIVISION OF HIGHWAYS

MISCELLANEOUS DETAILS

Designer	R. AKIN	Structure Numbers	H-4-S
Detailer	L. Sims		
Drawing Number B 14	of 15	Drawings	

AS CONSTRUCTED
REVISED DATE

FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	S0065(5)	19	

REVISIONS			
R-1	4-10-72	Revised Summary of Quantities	JJW

GENERAL NOTES

ALL WORK SHALL BE DONE ACCORDING TO THE STANDARD SPECIFICATIONS OF THE DIVISION OF HIGHWAYS, STATE OF COLORADO, APPLICABLE TO THE PROJECT.

USE GRADE 60 FOR ALL REINFORCING STEEL, EXCEPT TIES AND STIRRUPS UNLESS OTHERWISE NOTED. ALL TIES AND STIRRUPS ARE GRADE 40.

ALL CONCRETE SURFACES MARKED WITH THE SYMBOL ƒ AS SHOWN ON DRAWING NO. B1 SHALL RECEIVE A CLASS 2 SURFACE FINISH.

ALL CONCRETE CHAMFERS SHALL BE 3/4 INCH UNLESS OTHERWISE NOTED.

EXPANSION JOINT MATERIAL SHALL MEET A.A.S.H.O. SPECIFICATION M 213-65 UNLESS OTHERWISE NOTED.

SOUNDINGS AND DEPTH OF FOOTINGS ARE IN ACCORDANCE WITH THE BEST AVAILABLE DATA. WHEN DIFFERENT CONDITIONS ARE ENCOUNTERED, THE BRIDGE ENGINEER WILL INSPECT AND DETERMINE IF REDESIGN IS NECESSARY.

WHEN TREATED TIMBER PILING IS SHOWN ON THE PLANS, THE PRESERVATIVE FOR TREATMENT SHALL BE CREOSOTE OIL.

WHEN EXCAVATING FOR FOOTINGS, THE FINAL SIX INCHES IN DEPTH SHALL BE DONE BY HAND LABOR METHODS.

FOR DETAILS OF STRUCTURE EXCAVATION AND STRUCTURE BACKFILL, SEE STANDARD M-206-AA.

ALL STRUCTURAL STEEL NOT OTHERWISE NOTED SHALL BE A.A.S.H.O. SPECIFICATION M-183.

ALL STRUCTURAL STEEL NOT OTHERWISE NOTED SHALL BE PAINTED IN ACCORDANCE WITH SECTION 509 FOR (ALUMINUM) PAINT.

ALL BOLTS SHALL BE 3/4" DIAMETER, HIGH STRENGTH, UNLESS OTHERWISE NOTED.

NO WELDING OF ANY KIND SHALL BE PERMITTED ON THE FLANGES OF STEEL GIRDERS UNLESS SPECIFICALLY CALLED FOR IN THE PLANS.

EACH REINFORCING BAR SHALL BE TAGGED WITH BAR DESIGNATION, STRUCTURE NUMBER, AND STATION OF THE PROJECT. THE FIRST DIGIT OR DIGITS: 4-11 OF THE BAR DESIGNATION INDICATES THE BAR SIZE, EXAMPLE: 406 = #4 BAR, 1103 = #11 BAR, ETC. ALL DIMENSIONS ON BAR BENDING DIAGRAMS ARE OUT TO OUT. DIMENSIONS FOR REINFORCING BARS NOT SHOWN AS CLEAR SHALL BE TO THE CENTERLINE OF THE BAR. IF, BY PERMISSION OF THE ENGINEER, PRIMARY BARS ARE SPLICED, THEY SHALL LAP A MINIMUM OF 40 DIAMETERS.

ALL REINFORCING BAR SPLICES SHOWN IN THE SUPERSTRUCTURE SHALL HAVE A MINIMUM LAP OF 40 DIAMETERS UNLESS OTHERWISE NOTED. WHERE SPLICES CONTAIN BARS OF DIFFERENT DIAMETERS, THE SPLICE LENGTH SHALL BE GOVERNED BY THE SMALLEST BAR.

THE FOLLOWING TABLE SHOWS THE MINIMUM 40 DIAMETER LAP FOR COMMON BAR SIZES:

BAR SIZE	#4	#5	#6	#7	#8	#9	#10	#11
LAP	1'-8"	2'-1"	2'-6"	2'-11"	3'-4"	3'-10"	4'-3"	4'-9"

E.F. = EACH FACE
N.F. = NEAR FACE
F.F. = FAR FACE
B.E.I. = BY EQUAL INCREMENTS

CROSS REFERENCE DRAWING NUMBER

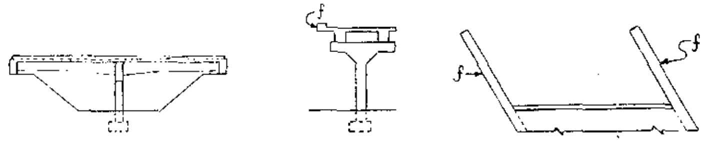
SECTION OR DETAIL IDENTIFICATION

SUMMARY OF QUANTITIES

Item	Description	Unit	Super-structure	Abut. 1	Pier 2	Abut. 3	Total
203	Unclassified Excavation	Cu Yd					165
204	Haul	Ton Mi	130				130
206	Structure Excavation	Cu Yd		180	135	365	680
206	Structure Backfill (Class 2)	Cu Yd		35	88	35	158
403	Hot Bituminous Pavement (Grading Dx)	Ton	62				62
411	Asphalt Cement (AC 5)	Ton	5				5
502	Steel Piling (14BP89)	Lin.Ft.		108	128	168	404
502	Reinforcing Tip	Each		6	8	6	20
506	Heavy Riprap	Cu Yd		551		1194	1745
509	Structural Steel	Lb			455		455
509	Structural Steel (Galvanized)	Lb.	11,740				11,740
515	Waterproofing (Membrane)	Sq.Yd.	790				790
601	Concrete Class A (Bridge)	Cu.Yd.		27.4	98.2	27.4	153.0
601	Concrete Class D (Bridge)	Cu.Yd.	321	18		18	357
602	Reinforcing Steel	Lbs.	111,702	4441	9386	4441	129,970 R-1
* 613	3 Inch Electrical Conduit (Plastic)	Lin.Ft.	334				334
626	Mobilization	L.S.					0.15

* All work to be done by contractor. (Non-federal-aid) Mountain Bell shall reimburse the Department for this work.

INDEX OF DRAWINGS



SURFACE FINISH DETAILS

BRIDGE DESCRIPTION

2-Spans (62'-0", 62'-0") Continuous Parabolic Concrete T-Beam Bridge.

Over Plateau Creek
56'-0" Roadway Curb to Curb 60°-0' skew
1'-3" curbs, Bridge Rail Type 1

LOADING DATA

LIVELOAD: A.A.S.H.O. HS-20-44 OR INTERSTATE ALTERNATE.
DEADLOAD: ASSUMES 20 LBS. PER SQ. FT. ADDITIONAL WEARING SURFACE. NO PROVISION HAS BEEN MADE FOR ADDITIONAL OVERLAYS.

DESIGN DATA

A.A.S.H.O. UNIT STRESSES, EXCEPT AS NOTED.

REINFORCING STEEL: F_s = 20,000 LBS. PER SQ. IN. FOR TRANSVERSE BARS IN ROADWAY SLAB ONLY.
F_s = 24,000 LBS. PER SQ. IN.

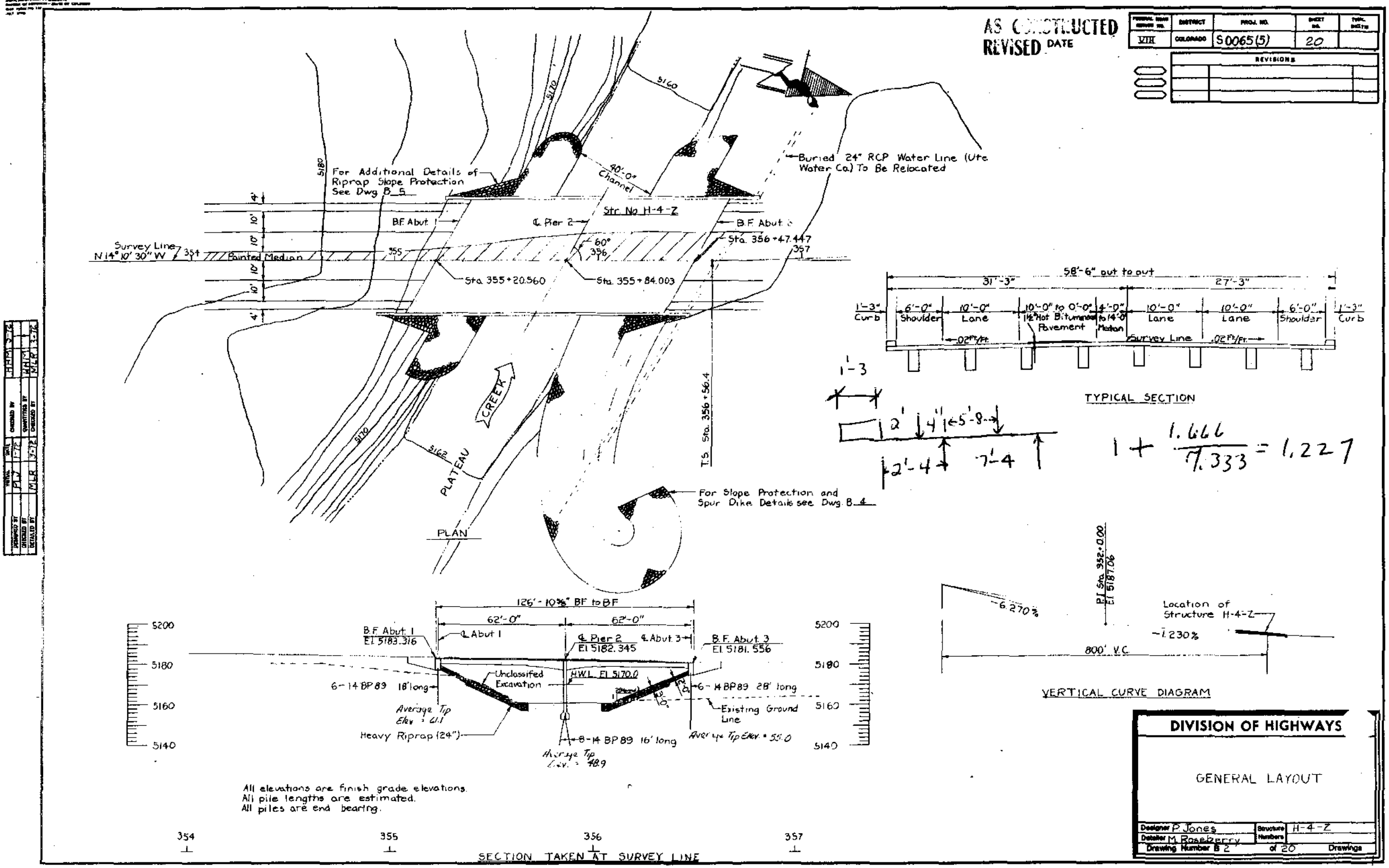
STRUCTURAL STEEL: A36 F_s = 20,000 LBS. PER SQ. IN.
A572, GRADE 50 F_s = 27,000 LBS. PER SQ. IN.

CONCRETE: F_c = 1,200 LBS. PER SQ. IN.
n = 10

Approved
P.E. 3/29/72
Bridge Engineer Date

DIVISION OF HIGHWAYS			
GENERAL INFORMATION SUMMARY OF QUANTITIES			
Station 355+20.560 to 356+47.447 Station			
Near Mesa Sec 18 T 10S. R 96 W.			
Designer P. Jones		Structure Numbers	H-4-Z
Detailer Mays			
Drawing Number B 1 of 20 Drawings.			

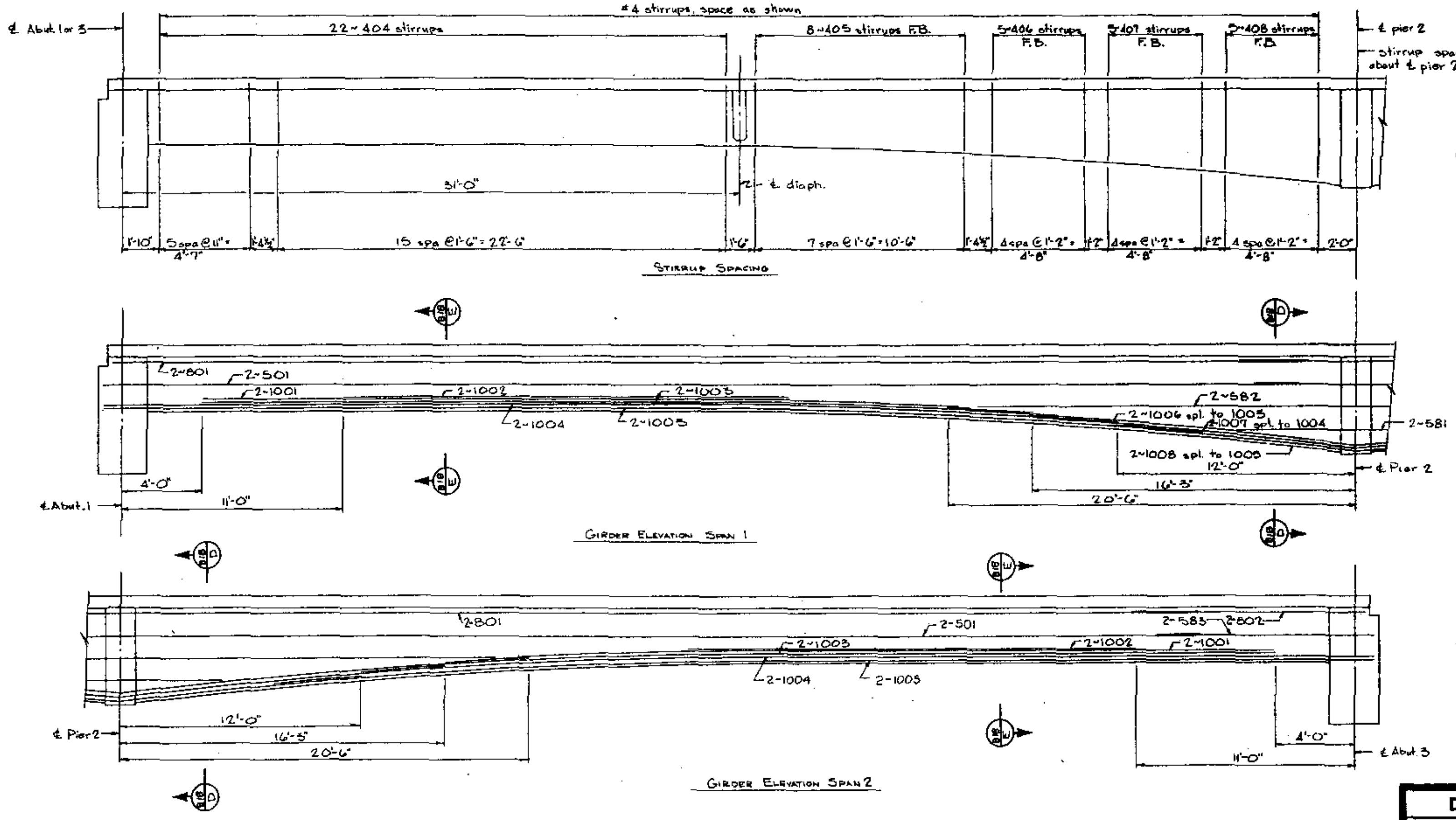
O(7-1-71)



28'
− 25.666
2.334'

Federal Road Region No.	District	Proj. No.	Sheet No.	Total Sheets
VIII	Colorado	S0065(5)	35	

	Revisions		
R-1	4-10-72	Added Note	T.D.B.



F.B. = Field Bend (R-1)

Initial	Date		
P.J.	1-72	Designed by / Checked by	N.H.M. 2-72
T.D.B.	2-72	Detailed by / Quantities by / Checked by	N.L.R. / N.H.M. 2-72

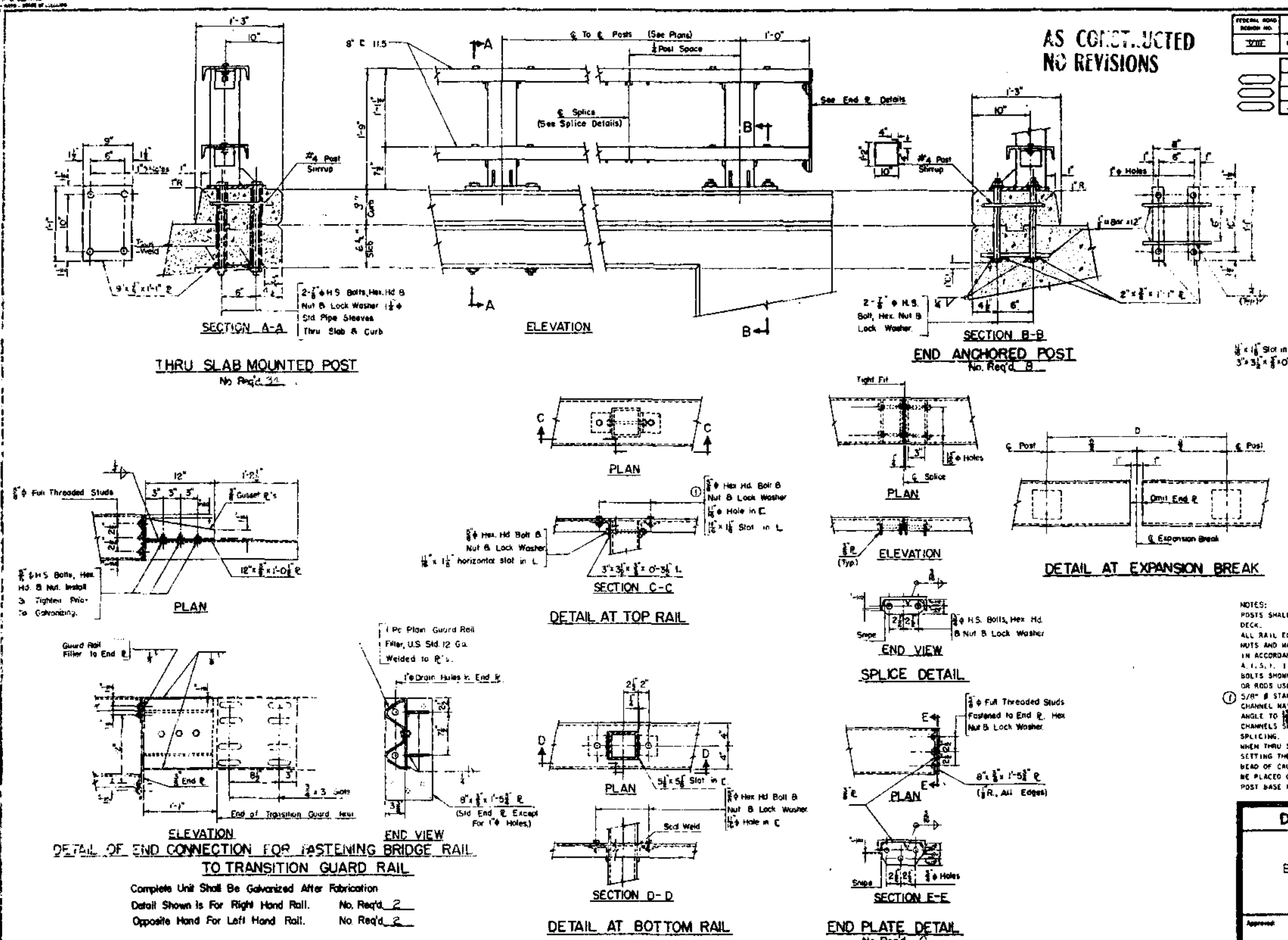
DIVISION OF HIGHWAYS

GIRDER REINFORCING

Designer P. Jones
Detailer T. Breder
Structure Numbers H-4-7
Drawing Number B 17 of 20 Drawings

FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	S 0065 (5)	37	

AS CONSTRUCTED
NO REVISIONS



NOTES:

POSTS SHALL BE PERPENDICULAR TO GRADE AND SLOPE OF THE DECK.

ALL RAIL ELEMENTS, ANCHOR ASSEMBLIES, ANCHOR BOLTS, NUTS AND WASHERS SHALL BE GALVANIZED AFTER FABRICATION IN ACCORDANCE WITH THE SPECIFICATIONS.

A.I.S.I. 1144 STEEL RODS MAY BE USED IN LIEU OF H.S. BOLTS SHOWN. 10° WEDGE TEST NOT REQ. FOR EITHER BOLTS OR RODS USED IN RAIL ASSEMBLY.

(1) 5/8" ϕ STANDARD FULL THREADED STUDS WELDED TO THE CHANNEL MAY BE USED. INCREASE SIZE OF SLOT IN THE ANGLE TO $\frac{13}{16}$" X $1\frac{1}{4}$"

CHANNELS SHALL BE CONTINUOUS OVER 3 OR 4 POSTS BEFORE SPLICING.

WHEN THRU SLAB MOUNTED POSTS ARE USED, PRIOR TO SETTING THE POSTS AND TIGHTENING THE NUTS A PERIMETER BEAD OF CAULKING GRADE, POLYURETHANE JOINT SEALER, SHALL BE PLACED ON THE CONCRETE 1" INSIDE THE EDGES OF THE POST BASE PLATE.

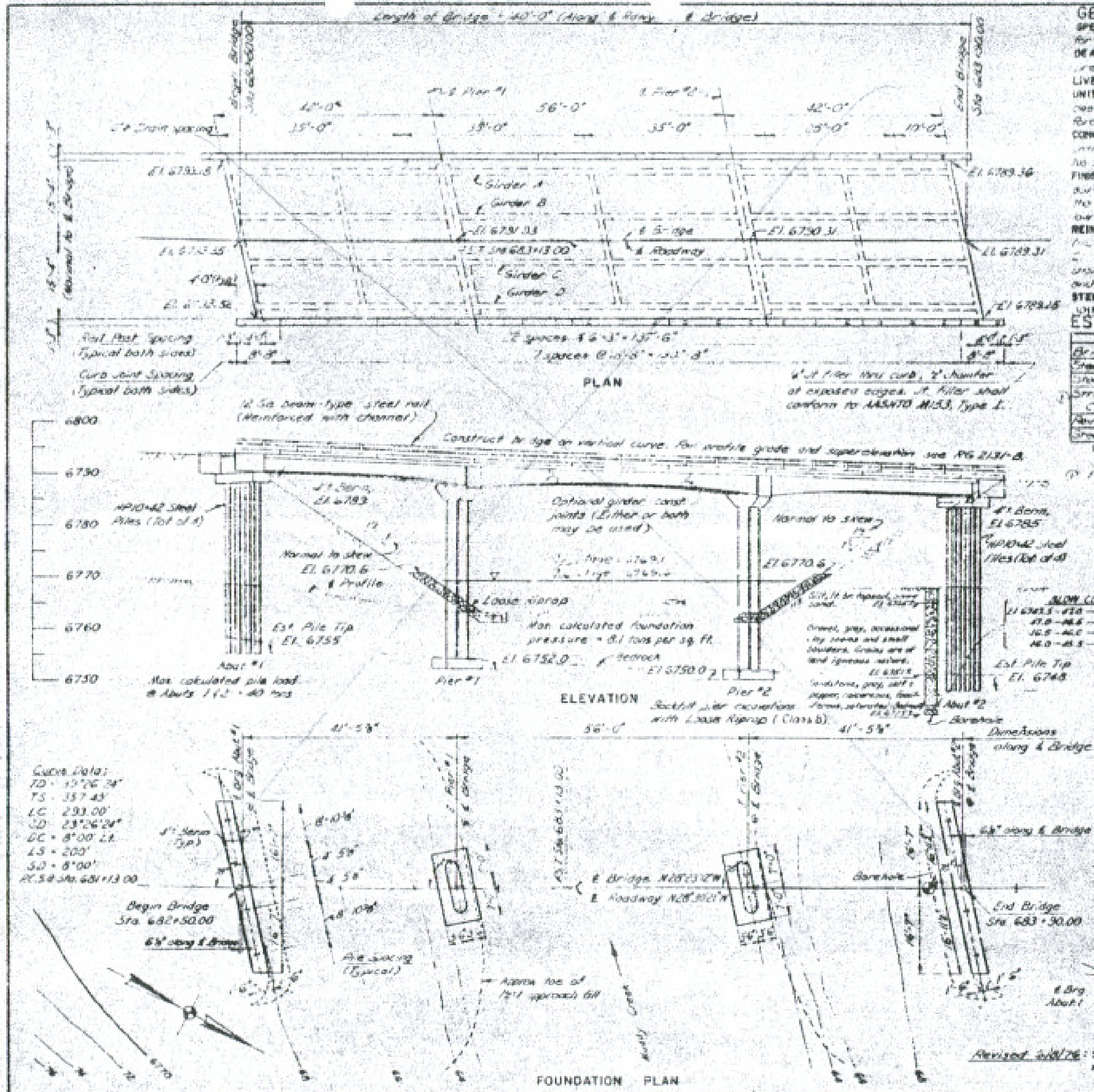
DIVISION OF HIGHWAYS

BRIDGE RAIL TYPE 1

Approved:
Bridge Engineer
Date:

Designer: P. Jones
Detailer: M. R.
Structure Numbers: H-4-Z
DWG. No. B 19 of 20

10 (9-1-71)



PLAN

ELEVATION

FOUNDATION PLAN

Sheet 25

GENERAL NOTES:

SPECIFICATIONS: Construction, Federal Highway Administration FP-[illegible]. Design AASHTO Standard Specifications for Highway Bridges, 1973, with 1974 and 1975 Interim Specifications.

DEAD LOAD: Concrete, 150 lbs. per cu. ft., paving allowance, 25 lbs. per sq. ft. of roadway surface, earth pressure equivalent to a fluid weighing 36 lbs. per cu. ft.

LIVE LOAD: HS20-44 Loading. Impact I = 50/(L+125) (L = Span Length). Maximum I = 30%.

UNIT STRESSES: Allowable stress in Class A(AE) concrete: fc = 1320 psi based on an assumed 28 day design strength of 3300 psi except for slab design where fc = 1200 psi. Allowable stress in reinforcing steel: fs = 20,000 psi. Modular Ratio n = 10.

CONCRETE: All concrete shall be Class A(AE). All concrete shall be mixed with an approved air entraining admixture and shall be vibrated. Chamfer exposed edges ¾" unless otherwise shown. No admixture containing calcium chloride shall be used. Cement shall be Type II, low alkali.

FINISHING CONCRETE: The roadway slab and curb shall be given a "Float Finish". The following surfaces shall be given a "Class 2 Finish": outside faces of the roadway slab, both faces of the curbs, exterior faces of exterior girders, and exposed faces of end wings to one foot below finished ground line. All other concrete surfaces shall be given a "Class 1 Finish".

REINFORCING STEEL: All conventional reinforcing steel shall conform to AASHTO M31, Grade 40 (ASTM A615, Grade 40). The minimum concrete covering to the face of any bar shall be 2" unless otherwise shown on the plans. Minimum splice lengths for all bar sizes shall be as shown in the plans. Bar splices other than those shown on the plans will not be paid for and must be approved by the Engineer.

STEEL BRIDGE RAILING: Steel bridge railing shall conform to the plans and specifications.

JOINT MATERIAL: Preformed joint filler shall conform to AASHTO M153.

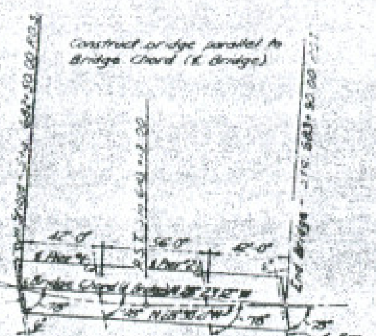
ESTIMATE:

Item	Unit	Superstr.	Abut 1	Pier 1	Pier 2	Abut 2	Total
Bridge Excavation	Cu. Yds.			80	30		130
Steel H-Piles, Furnished	Lin. Ft.		135			147	282
Steel H-Piles, Driven	Each		4			4	8
Structural Concrete Class A(AE)	Cu. Yds.	235.4	7.5	34.3	34.6	7.5	319.3
Reinforcing Steel	Pound	*64,686	1176	12,173	12,173	1176	*91,384
Steel Bridge Railing	Lin. Ft.	231					231

* Includes weight of guard angles and deck drains. Quantity shown is based on no optional girder const. joints being used.

Final Quantity

See Roadway Plans (RG 2131-C) for Loose Riprap details.



BRIDGE CONSTRUCTION LAYOUT

No Scale

Revised 2/18/76: ½" Concrete thickness added to top of slab.

BRIDGE NUMBER: H-7-I

DESIGNED BY FEDERAL HWY ADMINISTRATION
REGION 8 DENVER, COLORADO
OFFICE OF WESTERN BRIDGE DESIGN

APPROVED [signature]
DIRECTOR

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
REGION 8 DENVER, COLORADO

BRIDGE OVER MUDDY CREEK

STA. 683+21

McCLURE PASS ROAD

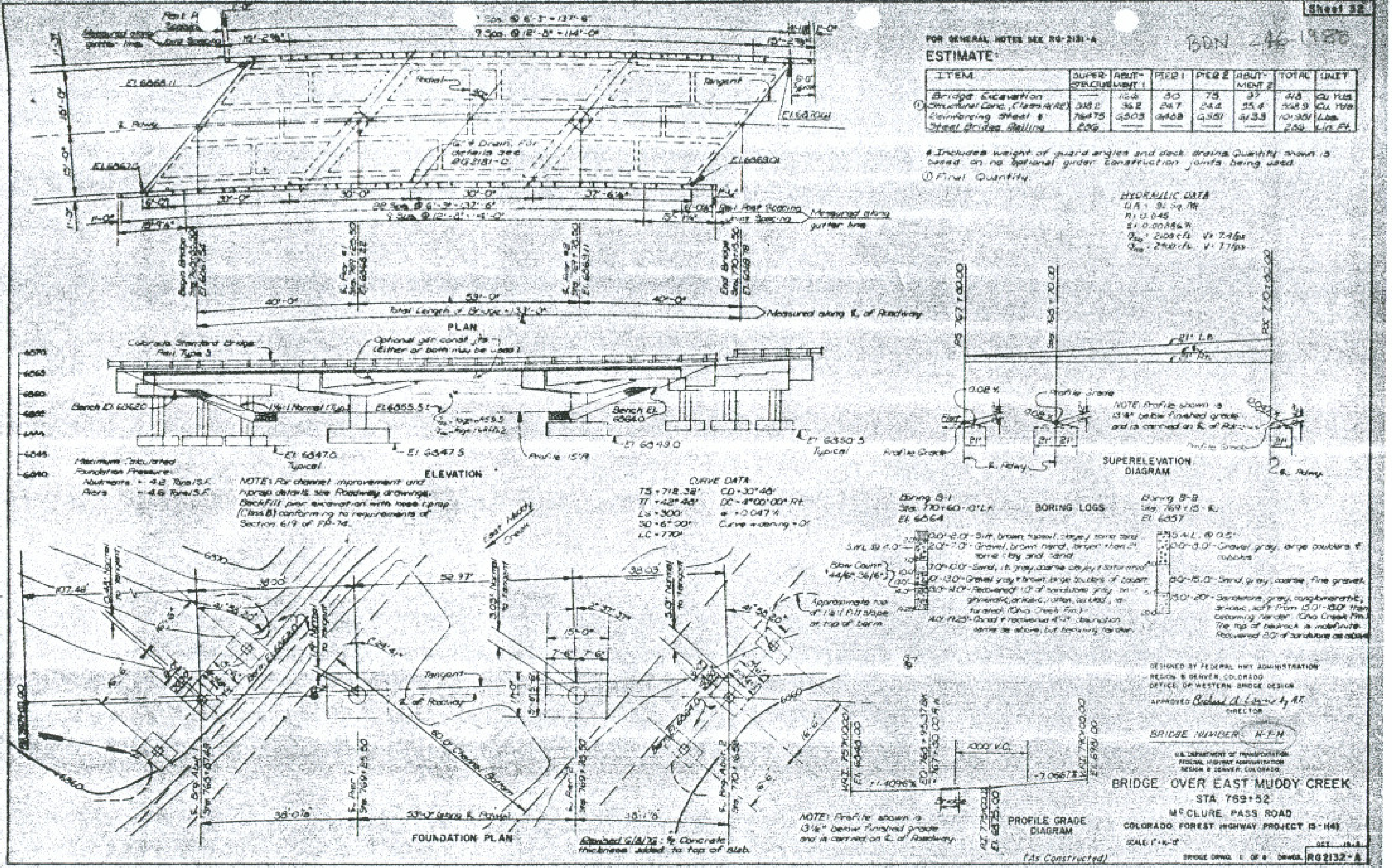
COLORADO FOREST HIGHWAY PROJECT 15-1(4)

SCALE: 1" = 10'-0"

BRIDGE DRWG. 1 OF 7

DRWG. RG 2131-A

(As Constructed)



FOR GENERAL NOTES SEE RG-2131-A

Sheet 32

BDN 246-1980

ESTIMATE:

ITEM	SUPER-STRUCTURE	ABUT-MENT 1	PIER 1	PIER 2	ABUT-MENT 2	TOTAL	UNIT
Bridge Excavation	—	164	80	75	97	418	Cu. Yds.
① Structural Conc. (Class A)(AE)	318.2	36.2	24.7	24.4	35.4	568.9	Cu. Yds.
Reinforcing Steel *	76475	6505	6468	6351	6133	101931	Lbs.
Steel Bridge Railing	286	—	—	—	—	286	Lin. Ft.

* Includes weight of guard angles and deck drains. Quantity shown is based on no optional girder construction joints being used.

① Final Quantity.

DESIGNED BY FEDERAL HWY ADMINISTRATION
REGION 9 DENVER, COLORADO
OFFICE OF WESTERN BRIDGE DESIGN

APPROVED Richard A. [illegible] by A.T.
DIRECTOR

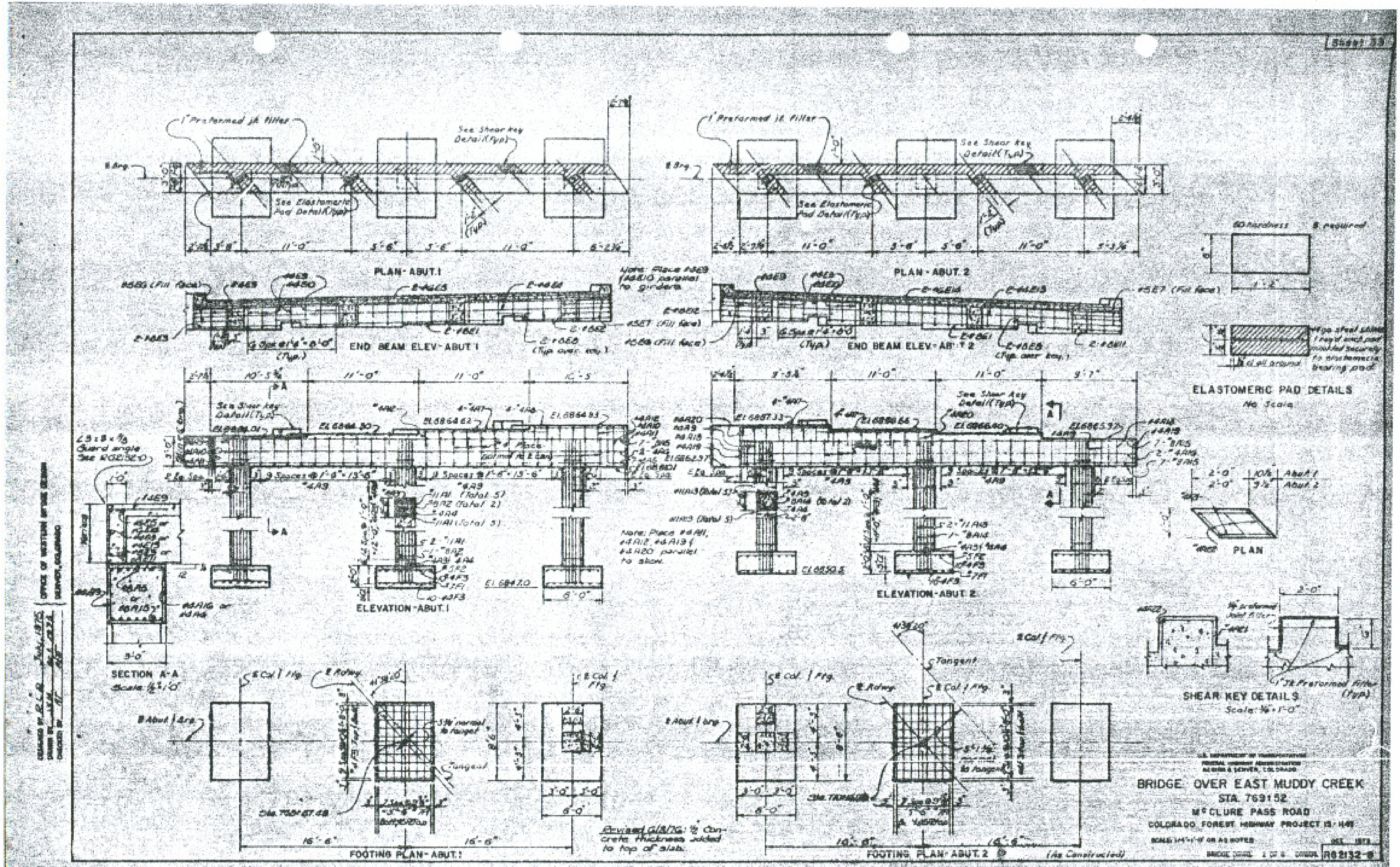
BRIDGE NUMBER H-7-M

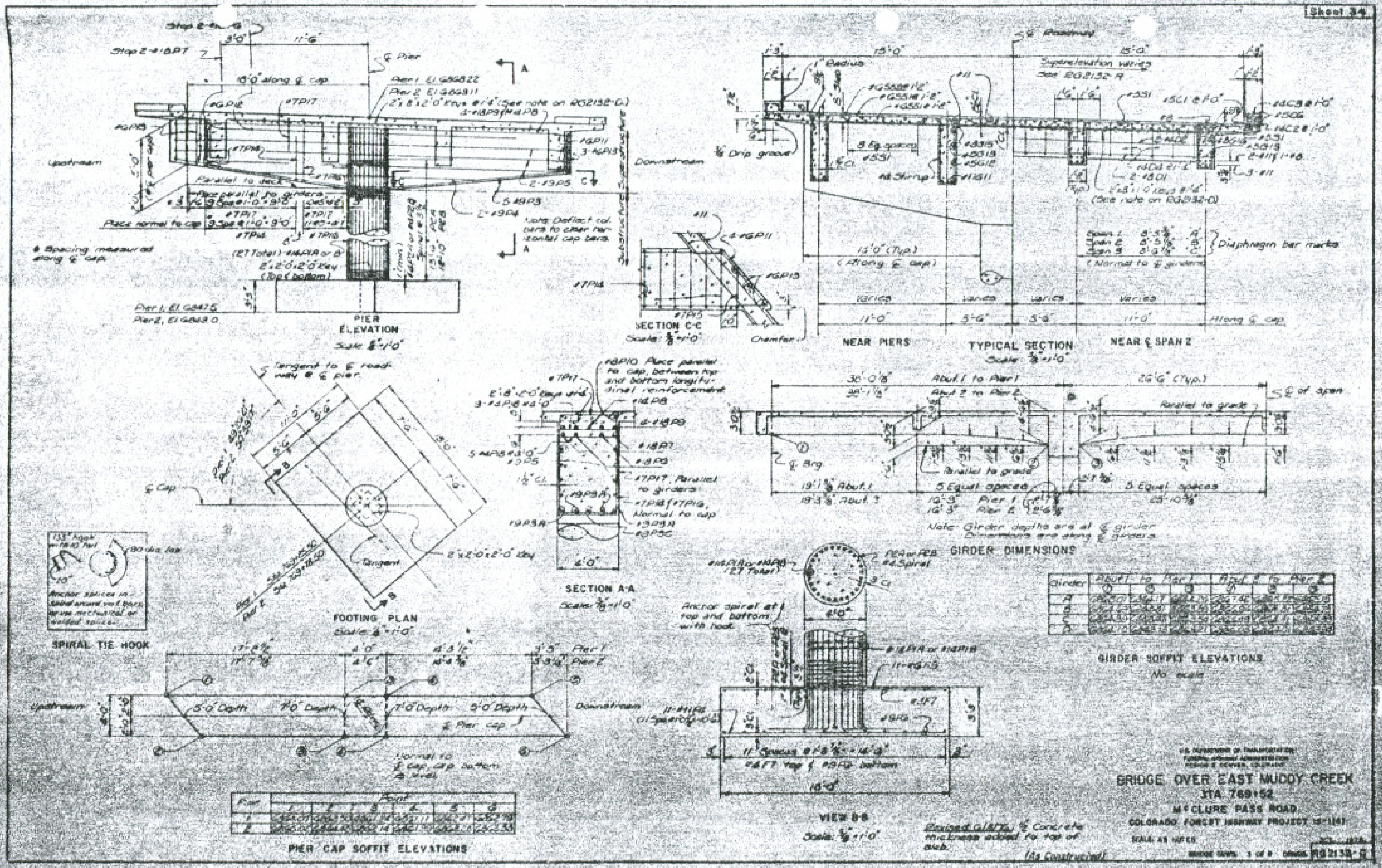
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
REGION 9 DENVER, COLORADO

BRIDGE OVER EAST MUDDY CREEK
STA 769+52
McCLURE PASS ROAD
COLORADO FOREST HIGHWAY PROJECT 15-1(4)

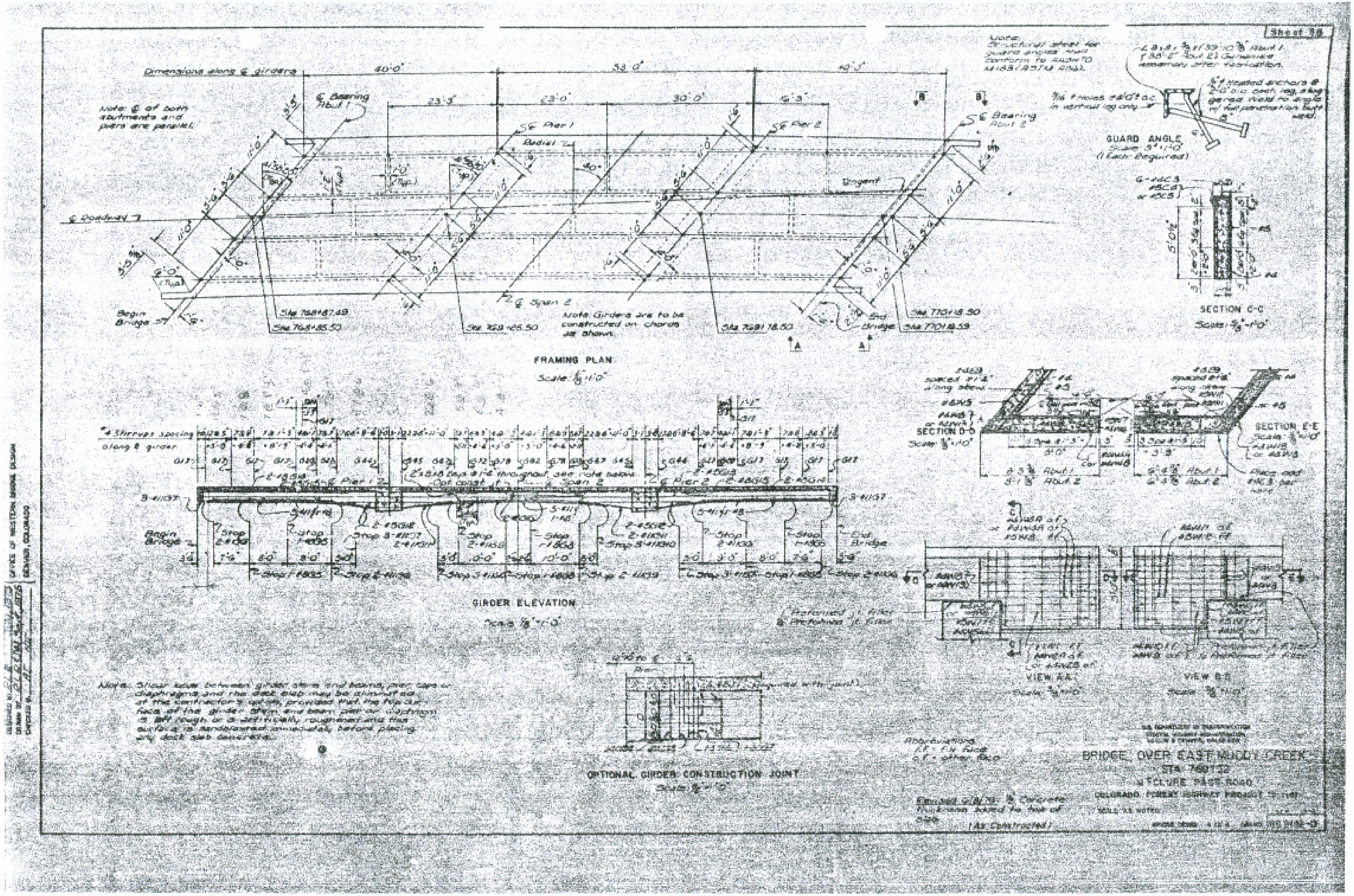
SCALE 1" = 10'-0"

BRIDGE DRWG. 1 OF 6 DRWG. RG2132-A

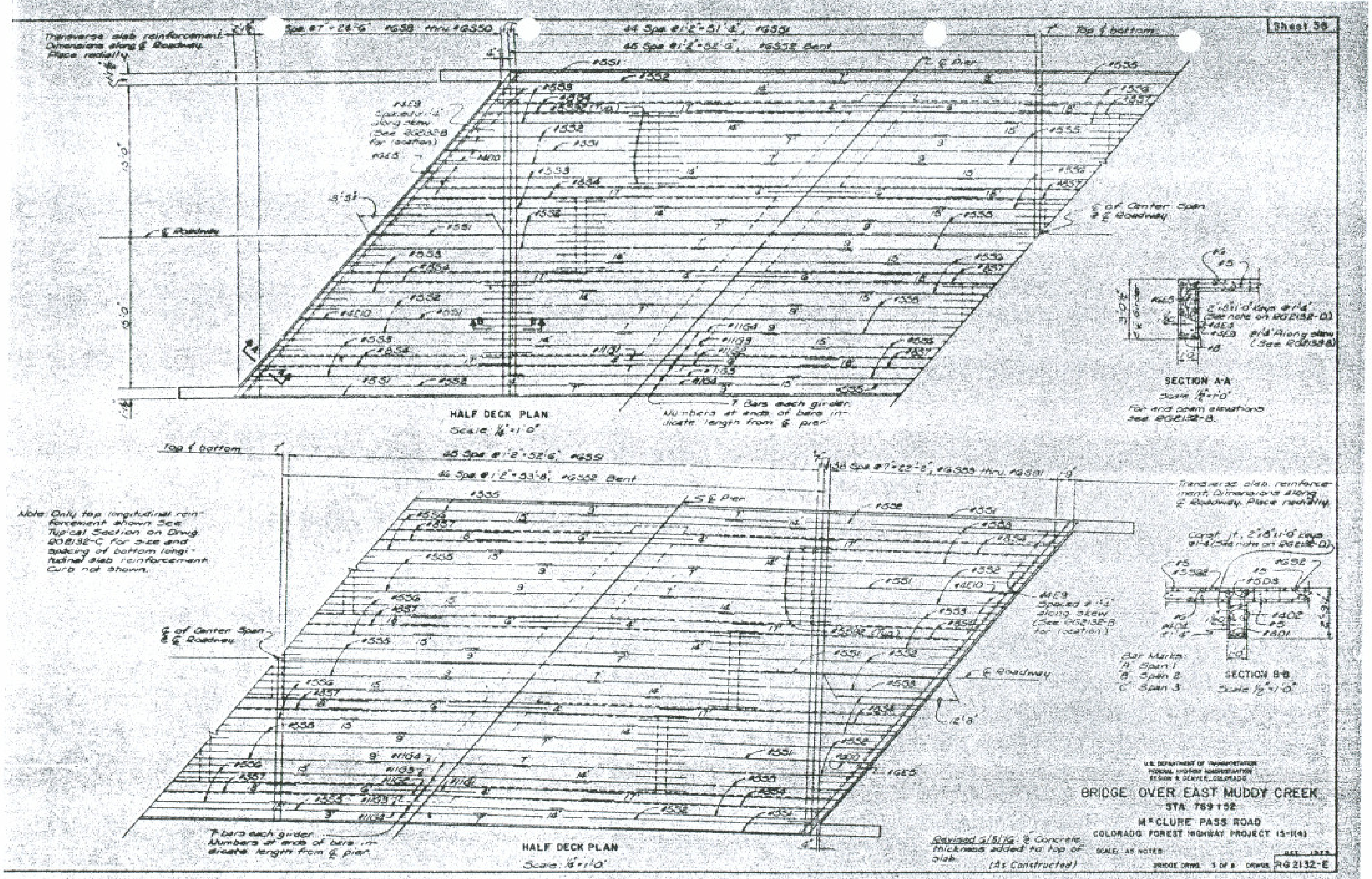

Sheet 33
PLAN - ABUT. 1
PLAN - ABUT. 2
1" Preformed jt. filler
See Shear key Detail (Typ)
See Elastomeric Pad Detail (Typ)
END BEAM ELEV - ABUT 1
END BEAM ELEV - ABUT 2
ELEVATION - ABUT. 1
ELEVATION - ABUT. 2
SECTION A-A
Scale: 1/2"=1'-0"
ELASTOMERIC PAD DETAILS
No Scale
PLAN
SHEAR KEY DETAILS
Scale: 3/4"=1'-0"
FOOTING PLAN - ABUT. 1
FOOTING PLAN - ABUT. 2
Revised 6/8/76: 1/2" Concrete thickness added to top of slab.
(As Constructed)
BRIDGE OVER EAST MUDDY CREEK
STA. 769+52
McCLURE PASS ROAD
COLORADO FOREST HIGHWAY PROJECT 13-1(4)
R62132-8

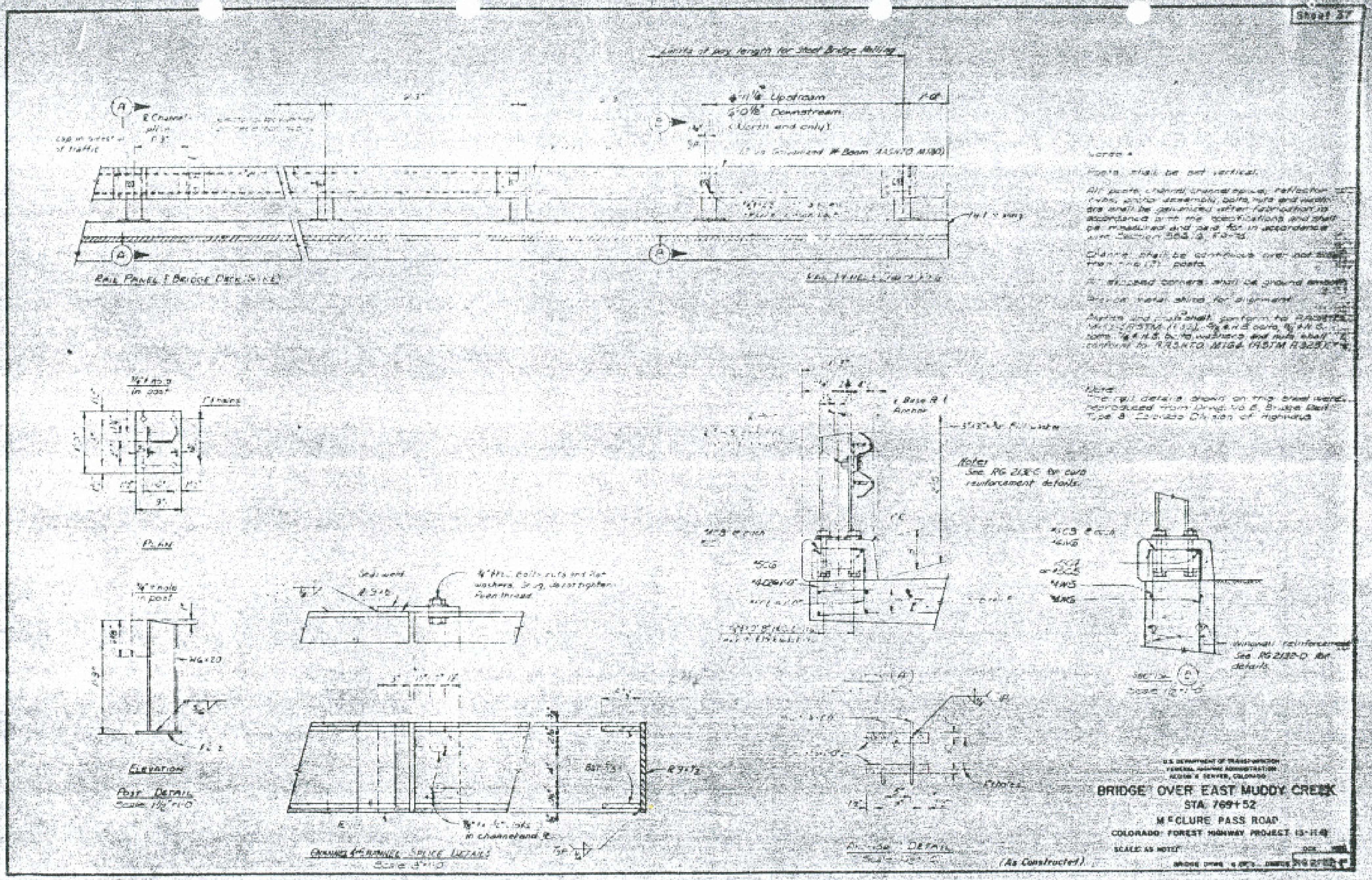


Sheet 34
PIER ELEVATION
SECTION C-C
TYPICAL SECTION
NEAR PIERS
NEAR ℄ SPAN 2
Upstream
Downstream
FOOTING PLAN
SECTION A-A
GIRDER DIMENSIONS
GIRDER SOFFIT ELEVATIONS
No scale
SPIRAL TIE HOOK
VIEW B-B
PIER CAP SOFFIT ELEVATIONS
(As Constructed)
BRIDGE OVER EAST MUDDY CREEK
STA. 769+52
McCLURE PASS ROAD
COLORADO FOREST HIGHWAY PROJECT
RG2132-G



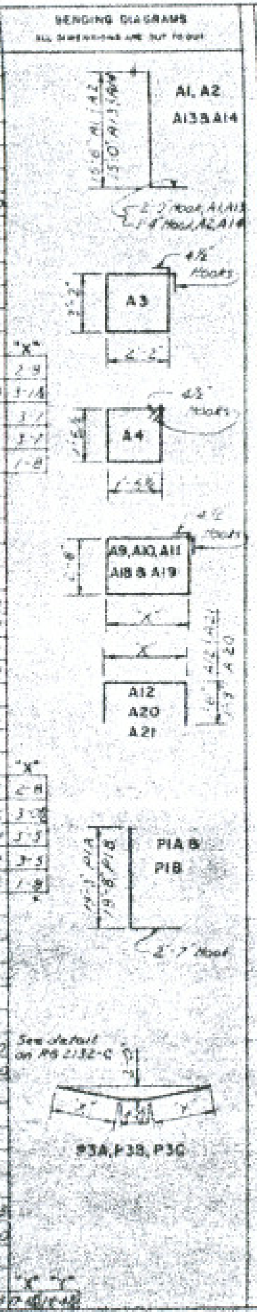
Sheet 38
FRAMING PLAN
GIRDER ELEVATION
GUARD ANGLE
SECTION C-C
SECTION D-D
SECTION E-E
VIEW A-A
VIEW B-B
OPTIONAL GIRDER CONSTRUCTION JOINT
BRIDGE OVER EAST MUDDY CREEK
McCLURE PASS ROAD
SCALE AS NOTED
(As Constructed)


Sheet 38
Transverse slab reinforcement. Dimensions along ℄ Roadway. Place radially.
HALF DECK PLAN
Scale: 1/4"=1'-0"
7 Bars each girder. Numbers at ends of bars indicate length from ℄ pier.
SECTION A-A
Scale 1/2"=1'-0"
For end beam elevations see RG2132-B.
Note: Only top longitudinal reinforcement shown. See Typical Section on Drwg. RG2132-C for size and spacing of bottom longitudinal slab reinforcement. Curb not shown.
℄ of Center Span & ℄ Roadway
℄ Roadway
℄ Pier
Transverse slab reinforcement. Dimensions along ℄ Roadway. Place radially.
Bar Marks:
A Span 1
B Span 2
C Span 3
SECTION B-B
Scale 1/2"=1'-0"
7 bars each girder. Numbers at ends of bars indicate length from ℄ pier.
HALF DECK PLAN
Scale: 1/4"=1'-0"
Revised 6/8/76. 3" Concrete thickness added to top of slab.
(As Constructed)
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
REGION 8 DENVER, COLORADO
BRIDGE OVER EAST MUDDY CREEK
STA. 769+52
McCLURE PASS ROAD
COLORADO FOREST HIGHWAY PROJECT 15-1(4)
SCALE: AS NOTED
BRIDGE DRWG. 5 OF 8 DRWG. RG 2132-E

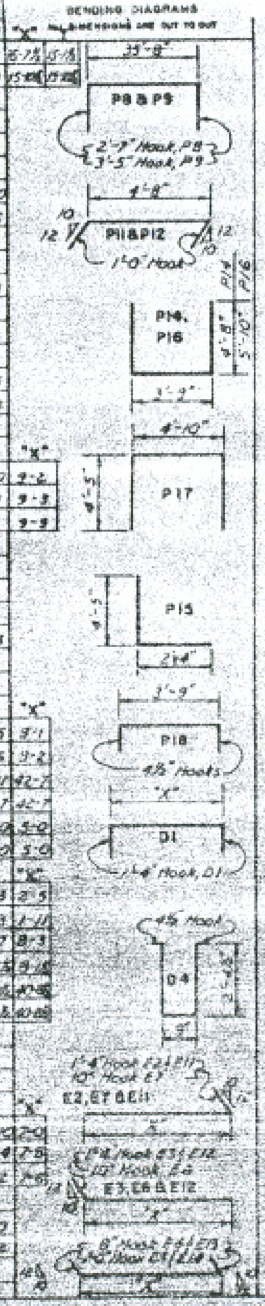

Sheet 37
Limits of pay length for Steel Bridge Railing
4'-11 1/4" Upstream
5'-0 1/8" Downstream
(North end only)
Rail Panel & Bridge Deck Splice
Notes:
Posts shall be set vertical.
All exposed corners shall be ground smooth.
Note:
The rail details shown on this sheet were reproduced from Drwg. No. 8, Bridge Rail Type 3, Colorado Division of Highways.
Notes:
See RG 2138-C for curb reinforcement details.
Plan
Elevation
Post Detail
Channel Rail Splice Details
Anchor Detail
Wingwall reinforcement See RG 2138-D for details
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
REGION 9 DENVER, COLORADO
BRIDGE OVER EAST MUDDY CREEK
STA. 769+52
M^cCLURE PASS ROAD
COLORADO FOREST HIGHWAY PROJECT 13-1(4)
SCALE: AS NOTED
(As Constructed)

Sheet 30

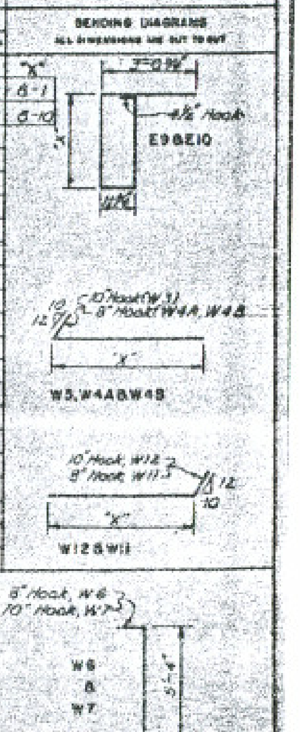
LOCATION	STRAIGHT BARS MARK	NO.	SIZE	LENGTH	BENT BARS MARK	NO.	SIZE	LENGTH	"X"
SUBSTRUCTURE									
Abutment 1									
Footing-Longit-Bott	F1	24	7	8-2					
" " " -Top	F2	24	5	8-2					
" -Transv.	F3	60	4	5-8					
Column-Vert.					A1	30	11	18-6	
" "					A2	6	8	17-10	
" Ties					A3	39	4	9-5	
" "					A4	39	4	6-11	
Cap-Horiz.	A5	14	8	42-7					
" "	A6	2	4	42-7					
" "	A7	4	4	12-0					
" "	A8	4	4	10-1					
" Tie					A9	24	4	11-5	2-9
" " Ends					A10	2	4	12-4	3-1[illegible]
" " "					A11	2	4	13-5	3-7
" Stirrup Stp					A12	16	4	6-7	3-7
" Shear Key					A21	4	4	4-8	1-8
" " "	A22	6	4	0-10					
Abutment 2									
Footing-Longit-Bott	F1	24	7	8-2					
" " Top	F2	24	5	8-2					
" Transv.	F3	60	4	5-8					
Column-Vert					A13	30	11	17-0	
" "					A14	6	8	16-4	
" Ties					A3	36	4	9-5	
" "					A4	36	4	6-11	
Cap-Horiz.	A15	14	8	40-9					
" "	A16	2	4	40-8					
" "	A7	4	4	12-0					
" "	A17	4	4	9-1½					
" Tie					A9	24	4	11-5	2-8
" "					A18	2	4	12-2	3-3
" "					A19	2	4	12-11	3-5
" "					A20	16	4	6-11	3-5
" Shear Key					A21	4	4	4-5	1-9
" " "	A22	6	4	0-10					
Pier 1									
Footing-Longit-Bott	F4	11	11	14-8					
" " " -Top	F5	11	6	14-8					
" -Transv-Bott	F6	12	9	10-8					
" " " Top	F7	12	4	10-6					
Column-Vert					P1A	27	14	21-11	See detail on PS 2132-C
" " Spiral					P2A	1	4	232-0	
Pier 2									
Footing-Longit-Bott	F4	11	11	14-9					
" " " Top	F5	11	6	14-8					
" Transv-Bott	F6	12	9	10-8					
" " Top	F7	12	4	10-6					
Column-Vert					P1B	27	14	21-5	
" Spiral					P2B	1	4	312-0	
SUPERSTRUCTURE									
Pier 1 & 2									"X" "Y"
Cap-Horiz-Bott					P3A	4	9	35-9	7-4[illegible] 12-4[illegible]



LOCATION	STRAIGHT BARS MARK	NO.	SIZE	LENGTH	BENT BARS MARK	NO.	SIZE	LENGTH	"X"	"Y"
Cap-Horiz-Bott					P3B	4	9	35-3	5-7⅞	15-⅛
" " "					P3C	2	9	35-9	15-[illegible]	15-[illegible]
Cap-Horiz.	P4	4	9	22-8						
" "	P5	12	9	35-8						
" "	P6	4	18	23-0						
" "	P7	4	18	29-0						
"					P8	2	14	40-10		
" "					P9	8	18	42-6		
" " Top	P10	4	8	38-0						
" " Ends					P11	8	6	6-8		
" " "					P12	8	6	6-8		
" Vert "	P13	6	6	4-4						
" Stirrups					P14	40	7	13-1		
" " Ends					P15	4	7	6-9		
					P16	48	7	15-5		
" " Top					P17	84	7	13-8		
" Ties					P18	28	4	4-6		
Diaphragms									"X"	
Horiz (Span 1)					D1A	6	8	11-10	9-2	
" -(Span 2)					D1B	6	8	11-11	9-3	
" -(Span 3)					D1C	6	8	12-1	9-5	
" (Span 1)	D2A	6	4	9-2						
" -(Span 2)	D2B	6	4	9-3						
" (Span 3)	D2C	6	4	9-5						
" " Slab	D3	18	5	10-0						
Stirrups					D4	34	4	6-3		
End Beams										
Horiz. Bott.	E1	4	8	19-8					"X"	
Horiz. Bott (End Abut 1)					E2	2	8	10-5	9-1	
" "					E3	2	8	10-6	9-2	
" Abut 1					E4	4	4	43-11	42-7	
" "					E5	2	6	44-7	42-7	
Horiz (End)					E6	6	5	5-10	5-0	
"					E7	6	5	5-10	5-0	
" Over Key	E8	8	8	6-0					"X"	
Stirrups					E9	46	4	9-3	2-5	
" Over Key					E10	4	4	8-3	1-11	
Horiz-Bott (End Abut 2)					E11	2	8	9-7	8-3	
" " " "					E12	2	8	9-5½	8-1½	
" Abut 2					E13	4	4	41-0½	40-[illegible]	
" "					E14	2	6	41-8½	40-8½	
Wingwalls										
Horiz (Abuts 1 & 2)	W1	4	4	5-8						
" (Abut 1)	W2A	2	4	6-8						
" (Abut 2)	W2B	2	4	6-8					"X"	
" "					W3	14	5	7-10	2-0	
" (Abut 1)					W4A	4	4	8-4	2-5	
" (Abut 2)					W4B	4	4	8-2	2-3	
Vert.	W5	22	4	3-4						
" "					W6	16	4	6-7		
" (@ Each Abut)					W7	8	5	6-2		
Vert Abut (1) Abut 2 (R&L)	W8	6	4	3-3						
Horiz.	W9	4	4	4-3						



LOCATION	STRAIGHT BARS MARK	NO.	SIZE	LENGTH	BENT BARS MARK	NO.	SIZE	LENGTH	"X"
Horiz.	W10	4	4	5-7					
"					W11	8	4	6-9	6-1
"					W12	14	5	7-8	6-10
Vert Abut (1 & 2) Abut 2 (L & R)	W13	6	4	3-5					



U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
REGION 9 DENVER, COLORADO

BRIDGE OVER EAST MUDDY CREEK
STA. 769+52
McCLURE PASS ROAD
COLORADO FOREST HIGHWAY PROJECT 15-1(6)

SCALE: NO SCALE

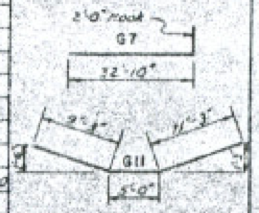
(As Constructed)

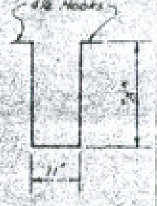
SHEET 7 OF 8

PS 2132-C

LOCATION	STRAIGHT BARS				BENT BARS				BENDING DIAGRAMS ALL DIMENSIONS ARE OUT TO OUT
	MARK	NO.	SIZE	LENGTH	MARK	NO.	SIZE	LENGTH	"X"
SUPERSTRUCTURE (CONTINUED)									
Girders									
Longit - Top	G1	8	11	10-0					
" "	G2	16	11	35-0					
" "	G3	16	11	29-0					
" "	G4	16	11	16-0					
" - Bot. Span 1 & 2	G5	8	8	8-0					
" " " "	G6	16	11	24-6					
" " " "					G7	24	11	34-10	
" " Span 2	G8	4	8	5-0					
" " " "	G9	8	11	25-0					
" " " "	G10	12	11	35-0					
" "					G11	16	11	25-6	
" Sides	G12	16	5	29-0					
" "	G13	8 lines	5	135-8	2 splices @ 1'-6" allowed per line.				
" "	G14	16	8	22-0					
" "	G15	16	8	35-0					
" "	G16	8	8	26-0					
Bdm Stirrups					G17	216	4	7-1	2-8½
" "					G18	6	4	7-1	2-8½
" "					G19	8	4	7-1½	2-8¾
" "					G20	8	4	7-2½	2-9⅛
" "					G21	8	4	7-3	2-9½
" "					G22	8	4	7-3½	2-9¾
" "					G23	8	4	7-4½	2-10⅛
" "					G24	8	4	7-5½	2-10¾
" "					G25	8	4	7-6½	2-11⅛
" "					G26	8	4	7-7½	2-11¾
" "					G27	8	4	7-8½	3-0⅛
" "					G28	8	4	7-9½	3-0¾
" "					G29	8	4	7-10½	3-1⅛
" "					G30	8	4	7-11½	3-1¾
" "					G31	8 ea.	4	8-1½	3-2⅛
" "					to G37			to	to
" "					G37	56	4	8-10	3-7
" "					G38	8	4	8-11½	3-7¾
" "					G39	8	4	9-1½	3-8¾
" "					G40	8	4	9-3	3-9½
" "					G41	8	4	9-5	3-10½
" "					G42	8	4	9-7	3-11½
" "					G43	8	4	9-9	4-0½
" "					G44	8	4	9-11½	4-1¾
" "					G45	8	4	9-11½	4-1¾
" "					G46	8	4	9-10	4-1
" "					G47	8	4	9-8½	4-0¼
" "					G48	8	4	9-7½	3-11¾
" "					G49	8	4	9-5	3-11
" "					G50	8	4	9-4½	3-10¼
" "					G51	8	4	9-3½	3-9¾
" "					G52	8	4	9-2	3-9
" "					G53	8	4	9-1	3-8½
" "					G54	8	4	8-11½	3-2¾
" "					G55	8	4	8-10½	3-7¼
" "					G56	8	4	8-9½	3-6¾

¾" Increments

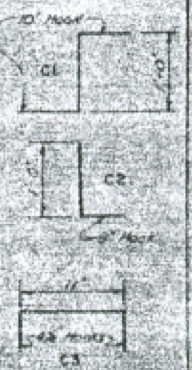




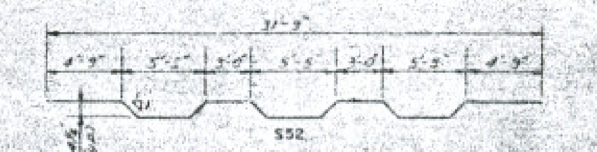
G17 THRU G82

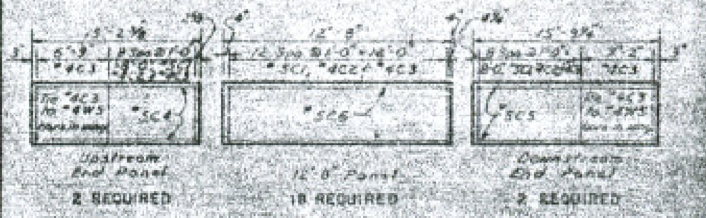
LOCATION	STRAIGHT BARS				BENT BARS				BENDING DIAGRAMS ALL DIMENSIONS ARE OUT TO OUT
	MARK	NO.	SIZE	LENGTH	MARK	NO.	SIZE	LENGTH	"X"
Gdr. Stirrups					G57	8 ea.	4	8-9	3-6
" "					to G64			to	to
" "					G64	64	4	8-1	3-2½
" "					G65	8	4	8-0½	3-2¼
" "					G66	8	4	7-11½	3-1¾
" "					G67	8	4	7-10½	3-1¼
" "					G68	8	4	7-10	3-1
" "					G69	8	4	7-9	3-0½
" "					G70	8	4	7-8	3-0
" "					G71	8	4	7-7½	2-11¾
" "					G72	8	4	7-6½	2-11¼
" "					G73	8	4	7-6	2-11
" "					G74	8	4	7-5	2-10½
" "					G75	8	4	7-4½	2-10¼
" "					G76	8	4	7-3½	2-9¾
" "					G77	8	4	7-3	2-9½
" "					G78	8	4	7-2½	2-9¼
" "					G79	8	4	7-2	2-9
" "					G80	8	4	7-1½	2-8¾
" "					G81	4	4	7-1	2-8½
" "					G82	4	4	7-1	2-8½
Slab									
Longit. Top & Bott.	S1	16 lines	5	136-0	2 Splices @ 1'-5" allowed per line.				
" Top	S2	16	5	34-3					
" "	S3	16	5	27-3					
" "	S4	16	8	25-11					
" "	S5	8	5	32-10					
" "	S6	8	5	25-10					
" "	S7	8	8	23-2					
Transverse Corner	S8	2 ea.	6	3-1					
" "	to S49			to	⅜" Increments				
" "	S50	86	6	31-1					
"	S51	85	6	31-11					
" (Bent)					S52	32	6	34-8	
" Corner	S53	2 ea.	6	31-0					
" "	to S79			to	⅞" Decrements				
" "	S91	78	6	2-11					
Longit. & Diaph.	S92	54	5	5-0					
Curbs									
Slab Dowel					C1	210	5	2-8	
" "					C2	210	4	1-8	
Ties - Top					C3	294	4	1-6	
Longit.	C4	4	5	14-8½					
"	C5	4	5	15-5					
"	C6	16	5	12-4					

⅛" Decrements



LOCATION	STRAIGHT BARS				BENT BARS				BENDING DIAGRAMS ALL DIMENSIONS ARE OUT TO OUT
	MARK	NO.	SIZE	LENGTH	MARK	NO.	SIZE	LENGTH	
OPTIONAL GIRDER CONSTRUCTION JOINTS									Bars shown are for one girder construction joint in one girder.
Horizontal	J1	4	8	6-0					





CURB REINFORCEMENT LAYOUT

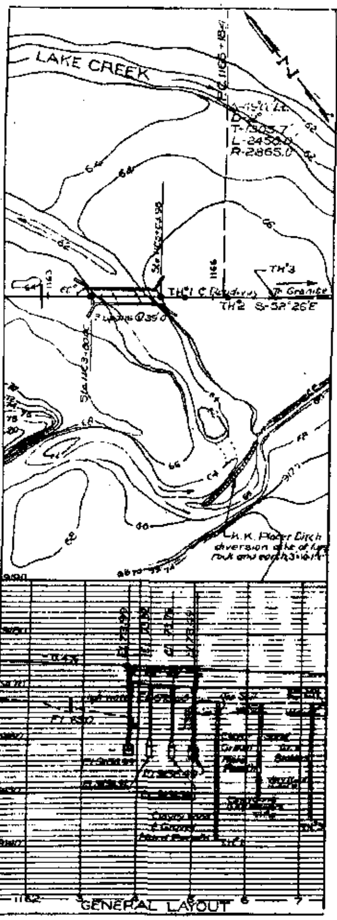
BRIDGE OVER EAST MUDDY CREEK
STA 759+52
McCLURE PASS ROAD
COLORADO FOREST HIGHWAY PROJECT

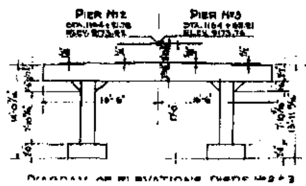
(As Constructed)

REV 4-4-1947 JEE. GENERAL NOTES - ADD ADOPTED JUNE 1, 1946 & - AND ONE SHOP COAT OF RED LEAD PAINT.

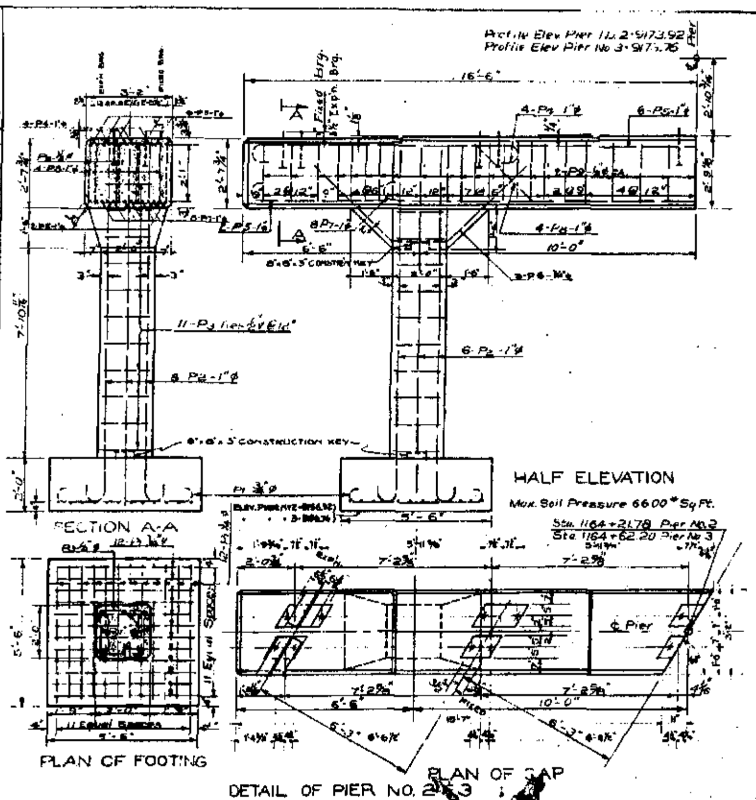
FED. ROAD DIST. NO.	STATE	F.A.S. PROJ. NO.	SHEET NO.	TOTAL SHEETS
3	COLO.	S-423 (3)	6-A	

NEW SHEET 8/3/46
REVISED CONSTRUCTION DIVISIONS 9.30.46. G.H.D.
COMBINED " " 4-18-47- JEE.





LOOKING EAST



DETAIL OF PIER NO. 2 & 3

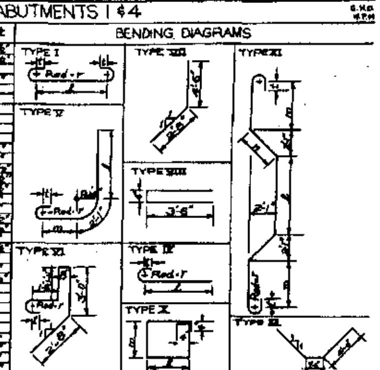
BARLIST FOR ABUTMENTS 1 & 4

MARK	SIZE	NO. OF BARS ABUT. No1	NO. OF BARS ABUT. No4	LENGTH	TYPE	ℓ	m	n	r	t
A1	1"φ	36	36	14'-4"	IX	13'-0"			4"	3½"
A2	1"φ	36	36	12'-5"	V	6'-1"	2'-11"		4"	3½"
A3	½"φ	24	24	22'-0"	—	BEND	IN	FIELD		
A4	½"φ	34	34	10'-5"	III				2"	2"
A5	¾"φ	10	10	37'-7"	—	BEND	IN	FIELD		
A6	½"φ	8	8	7'-2"	VIII					
A7	½"φ	12	12	3'-6"	—					
H7	½"φ	5	5	7'-4"	VIII					
~~H8~~	[illegible]	[illegible]	[illegible]	[illegible]						
B1	⅝"φ	4	4	8'-6"	IX	7'-8"			2½"	2"
B2	⅝"φ	4	4	9'-6"	IX	8'-8"			2½"	2"
B3	⅝"φ	4	4	10'-9"	IX	9'-8"			3"	2½"
B4	⅝"φ	4	4	11'-9"	IX	10'-9"			3"	2½"
B5	⅝"φ	4	4	12'-9"	IX	11'-9"			3"	2½"
B6	¾"φ	4	4	14'-0"	IX	12'-10"			3½"	3"
B7	¾"φ	4	4	15'-0"	IX	13'-0"			3½"	3"
B8	1"φ	4	4	16'-3"	IX	14'-11"			4"	3½"
B9	1"φ	2	2	17'-1"	IX	15'-9"			4"	3½"
B10	⅝"φ	8	8	6'-0"	V	2'-6"	0'-7"		2½"	2"
B11	⅝"φ	8	8	7'-9"	V	3'-7"	1'-7"			2½"
B12	¾"φ	8	8	9'-4"	V	4'-7"	1'-6"		3½"	3"
B13	¾"φ	6	6	10'-10"	V	5'-7"	2'-0"		3½"	3"
B14	1"φ	6	6	11'-11"	V	6'-2"	2'-4"		4"	3½"
B15	½"φ	12	12	20'-3"	—					
B16				18'-8"						
7A	½"φ	2 EA.	2 EA.	3'-5½"	—					
B23				BY 2'-2"						
F1	⅝"φ	64	64	8'-8"	IX	8'-10"			2½"	2"
F2	⅝"φ	20	20	6'-3"	IX	8'-5"			2½"	2"
F3	⅝"φ	12	12	5'-11"	IX	5'-1"			2½"	2"
F4	⅝"φ	8	8	5'-5"	IX	4'-7"			2½"	2"
F5	⅝"φ	6	6	4'-3"	IX	3'-5"			2½"	2"
F6	⅝"φ	26	26	9'-6"	I	7'-10"			2½"	2"
F7				8'-10" To		7'-2" To				
7D	⅝"φ	1 EA.	1 EA.	6'-4"	I	4'-8"			2½"	2"
F18				BY 3½"		BY 3½"				
F19				9'-3" To		7'-7"				
7D	⅝"φ	1 EA.	1 EA.	8'-9"	I	6'-1"			2½"	2"
F26				BY 3"		BY 3"				
F27	⅝"φ	3	3	32'-0"	—	BEND	IN	FIELD		
F28	⅝"φ	2	2	10'-6"	—					
F29	⅝"φ	6	8	31'-0"	—	BEND	IN	FIELD		
F30	⅝"φ	4	4	33'-0"	—	"	"	"		
F31	⅝"φ	6	6	29'-0"	—	"	"	"		
F32	⅝"φ	4	4	25'-6"	—	"	"	"		
F33	⅝"φ	3	3	27'-0"	—	"	"	"		
F34	⅝"φ	2	2	26'-0"	—	"	"	"		
F35	⅝"φ	5	5	7'-6"	IX	6'-6"				

1836 Lin. Ft. ⅝"φ Bars @ 0.668 Lbs. Per Lin. Ft. = 1227 Lbs.
2231 " " ¾"φ " " 1.043 " " " " = 2327 "
219 " " ⅞"φ " " 1.502 " " " " = 329 "
125 " " ⅞"φ " " 2.044 " " " " = 256 "
1134 " " 1"φ " " 2.670 " " " " = 3028 "
1%± for Overrun = 73 "
Total For Each Abutment = 7240 Lbs.

G.H.D. W.P.M.

BENDING DIAGRAMS



BARLIST FOR PIERS NO. 2 & 3

MARK	SIZE	NO. OF BARS PIER No2	NO. OF BARS PIER No3	LENGTH	TYPE	ℓ	m	n	r	t
P1	⅝"φ	48	48	5'-4"	I	4'-4"			3"	2½"
P2	1"φ	16	16	14'-2"	[illegible]	11'-10"			4"	3½"
P3	⅝"φ	22	22	7'-[illegible]	[illegible]	1'-7⅜"	1'-7⅜"			
P4	1"φ	8	8	11'-8"	I	9'-6"			4"	3½"
P5	1"φ	8	8	34'-4"	I	31'-6"			4"	3½"
P6	¾"φ	8	8	15'-0"	[illegible]					
P7	1"φ	8	8	24'-4"	I	22'-0"			4"	3½"
P8	1"φ	4	4	36'-1"	[illegible]	11'-10"	7'-10"	2'-11⅞"	4"	3½"
P9	⅝"φ	96	96	8'-8"	[illegible]	1'-9⅜"	2'-5⅜"			

936 Lin. Ft. ⅝"φ Bars @ 0.668 Lbs. Per Lin. Ft. = 627 Lbs.
364 " " ⅞"φ " " 1.502 " " " " = 547 "
936 " " 1"φ " " 2.670 " " " " = 2499 "
1%± For Overrun = 37 "
Total For Each Pier = 3710 Lbs.

G.H.D. W.P.M.

SUMMARY OF QUANTITIES FOR ENTIRE STRUCTURE

ITEM No.	DESCRIPTION	UNIT	SUPER STR.	ABUT. No1	PIER No2	PIER No3	ABUT. No4			GRAND TOTAL
13c	UNCLASSIFIED EXCAVATION	CU.YD.		90			245			335
14a	DRY ROCK STRUCTURAL EXCAVATION	" "					10			10
14b	" COMMON " "	" "					30			30
14c	WET ROCK " "	" "		70	7	7	86			170
14d	" COMMON " "	" "		142	14	14	170			340
15y	SELECTED BACKFILL	" "		270	15	15	260			560
42a	UNTREATED BRIDGE TIMBER	M.FT.B.M.	0.35							0.35
46a	CLASS "A" CONCRETE	CU.YD.	1030	98.7	18	18	98.7			841
46r	" " " (HANDRAILS)	" "	9.3	0.6			0.6			10.5
47	REINFORCING STEEL (1% OVERRUN INCL'D)	LB.	[illegible]	7240	3710	3710	7240			~~[illegible]~~
48	STRUCTURAL " (1.5% " ")	"	71,120	24	47	47	24			71262
80c	SHEET COPPER (36 OZ.)	"	311							311
89a	DRAIN PIPE, CONCRETE FLOOR 4"x3'-0"	EA.	6							6
♦	½" EXPANSION JOINT MATERIAL	SQ.FT.	118	36			36			190
♦	No12 GA. GALV. SHEET METAL	" "	116							116
	♦ INCLUDED IN BID PRICE OF ITEM 46a									

22090

44070

Note:
Details of Superstructure
See Sheet No. 6-B
Details of Abutments Nos. 1 and 4
See Sheet No. 6-C

GENERAL NOTES

ALL WORK SHALL BE DONE ACCORDING TO THE STANDARD SPECIFICATIONS OF THE COLORADO STATE HIGHWAY DEPARTMENT, ADOPTED JUNE 1, 1946.

ALL CONCRETE SHALL BE CLASS "A."

FORMS FOR CONCRETE SURFACES EXPOSED IN THE FINISHED WORK SHALL BE CONSTRUCTED OF SHIPLAP OR TONGUE AND GROOVE LUMBER S2S UNLESS FACED WITH PANEL BOARD.

CONCRETE GIRDERS, FLOOR SLABS AND CURB SHALL BE POURED MONOLITHICALLY.

FOOTINGS IN ROCK SHALL BE POURED OUT TO THE ROCK AND NOT FORMED.

ALL REINFORCING BARS SHALL BE DEFORMED AND TAGGED WITH THE STATION NUMBER AND LETTER DESIGNATION. MAIN BARS SHALL NOT BE SPLICED.

SOUNDINGS AND DEPTH OF FOOTINGS SHOWN ARE ACCORDING TO THE BEST AVAILABLE DATA. IF ESSENTIALLY DIFFERENT CONDITIONS ARE ENCOUNTERED THE BRIDGE ENGINEER WILL INSPECT AND DETERMINE IF REDESIGN IS NECESSARY.

ALL RIVETS TO BE ¾ DIA. ALL RIVETS TO BE POWER DRIVEN.

REINF. STEEL SHALL BE OF INTERMEDIATE GRADE.

ALL STRUCTURAL STEEL TO HAVE TWO FIELD COATS OF ALUMINUM PAINT, AND ONE SHOP COAT OF RED LEAD PAINT.

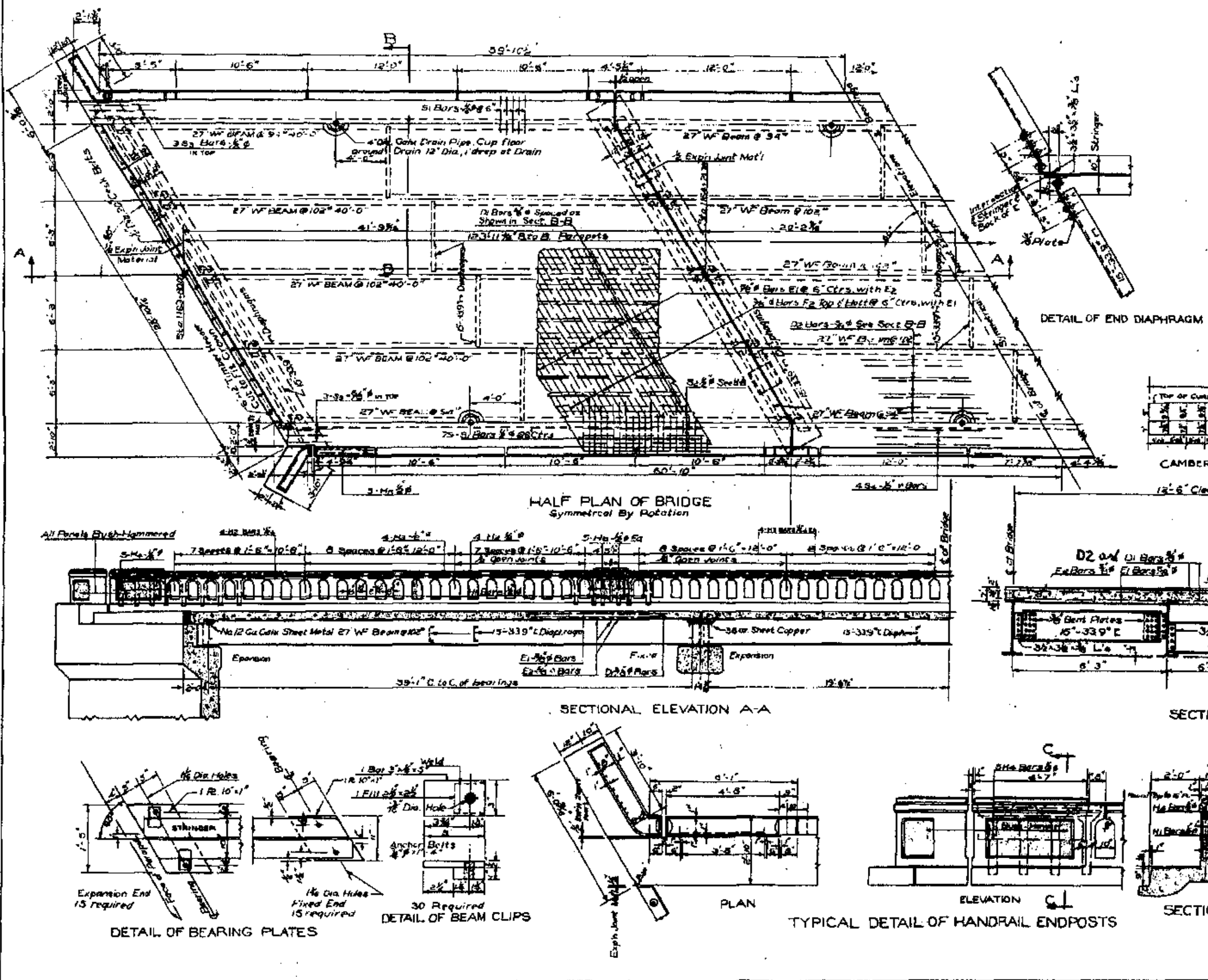
LOADING DATA.
LIVE LOAD A. A. S. H. O. [illegible] H20 44
DEAD LOAD - ALLOWANCE 15 LBS. PER SQ. FT. [illegible] AL WEARING SURFACE WHICH INCLUDES THE [illegible] CONCRETE MONOLITHIC WEARING SURFACE SHOWN

DESIGNING DATA.
fs = 15000
fc = 800
n = 12

COLORADO
STATE HIGHWAY DEPARTMENT
3 SPANS @ 39'-1" CONCRETE I BEAM
GENERAL LAYOUT, DETAILS OF PIERS BARLIST OF ABUTMENTS AND SUMMARY OF QUANTITIES
Across LAKE CREEK
Sta. 1163+50.00 TO 1165+[illegible]
Near GRANITE Sec. 23 T. 11S R. [illegible]
Designed by G.H.D. Approved by [illegible]
Made by G.H.D. Bridge Engineer

	STATE	F.A.S.	SHEET	
3	COLO.	S-423 (3)	6-8	

NEW SHEET 8/3/46
REVISED CONSTRUCTION DIVISIONS 9-26-46. G.H.D.
COMBINED " " 4-18-47 J.E.E.

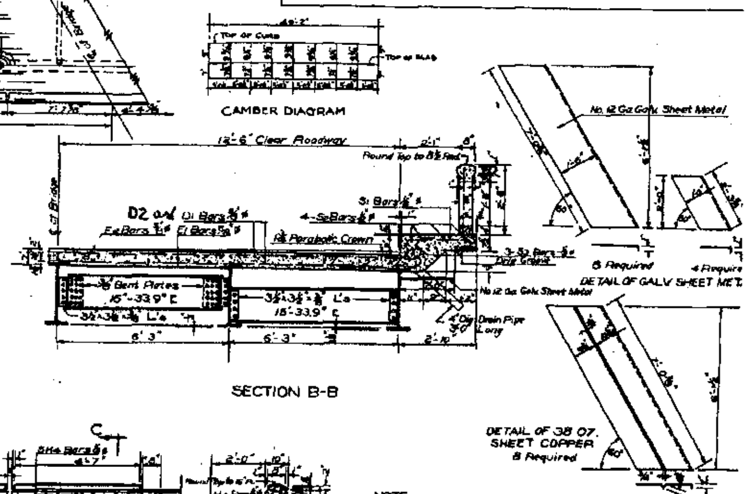


BAR LIST FOR ENTIRE SUPERSTRUCTURE

MARK	SIZE	NO.	LENGTH	TYPE	l	m	r	t
E1	⅝"φ	282	32'-10½"	II			2½"	
E2	⅝"φ	71	32'-2"	I	30'-6"		2½"	2"
D1	⅝"φ	184	21'-7"	—				
D2	⅝"φ	45	40'-0"	—				
S1	½"φ	400	5'-10"	III	1'-7"	1'-6"	2"	2"
S2	½"φ	32	21'-2"	—				
S3	⅝"φ	12	4'-3"	IV	3'-5"		2½"	2"
S4	½"φ	8	39'-6"	—				
H1	½"φ	168	6'-0"	IV				
H2	½"φ	40	10'-2"	—				
H3	½"φ	32	11'-8"	—				
H4	½"φ	10	4'-7"	—				
H5	½"φ	10	3'-11"	—				
H6	½"φ	40	1'-8"	—				
H8	½"φ	24	5'-6"	—	FOR ENDPOSTS [illegible]			

BENDING DIAGRAM: TYPE I, TYPE II, TYPE III, TYPE IV

5933 Lin Ft. ½"φ Bars @ 0.668 Lbs. Per Lin. Ft. = 3964 LBS.
17417 Lin Ft ⅝"φ " @ 1.043 " " " " = 18166 "
1% For Overrun = 220 "
Total = 22350 LBS.



NOTE

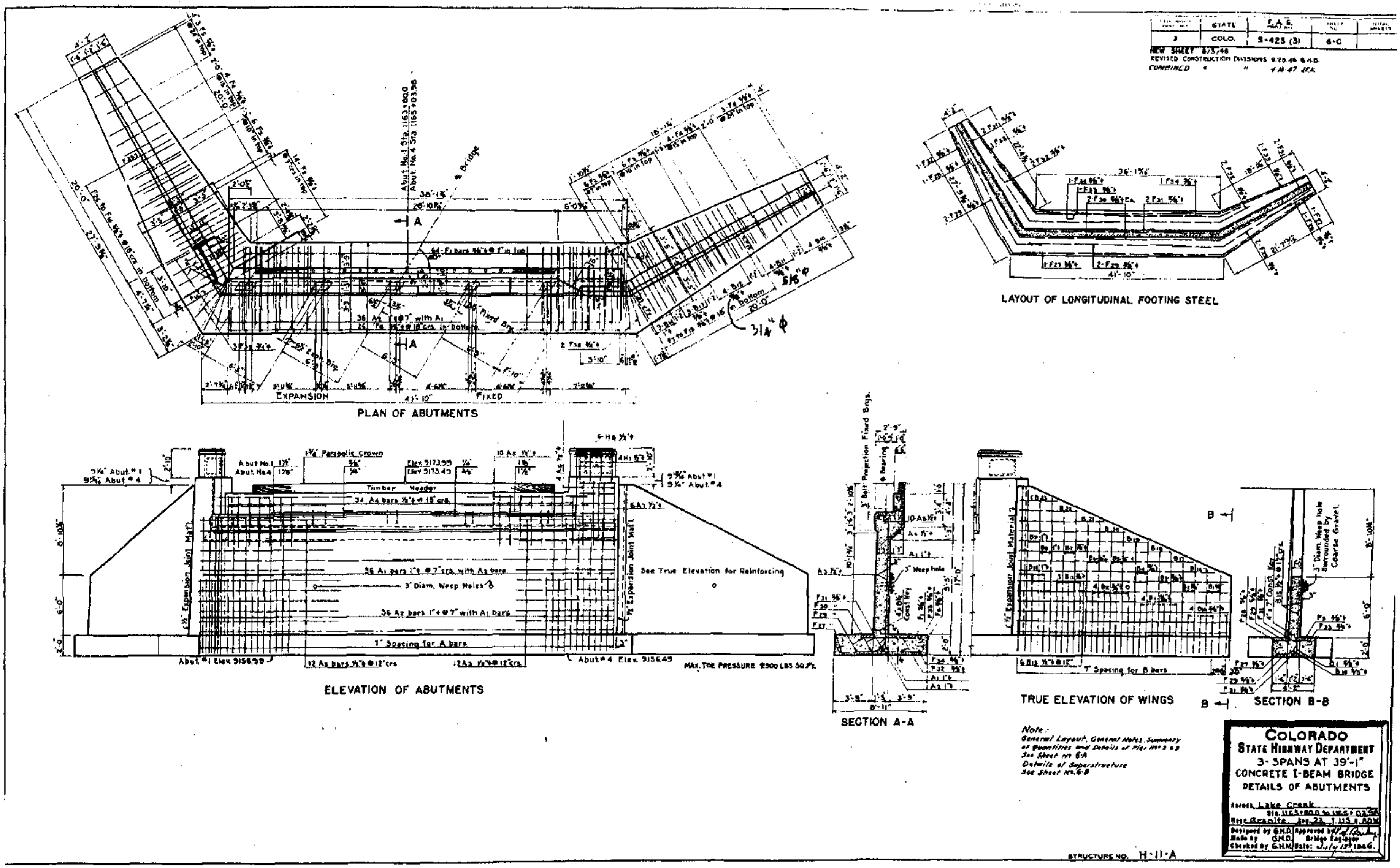
General Layout, General Notes, Summary of Quantities and Details of Pier Nos. 2 and 3 See Sheet No. 6-A
Details of Abutments Nos. 1 and 4 See Sheet No. 6-C

STRUCTURE NO. H-11-A

COLORADO
STATE HIGHWAY DEPARTMENT
3 SPAN @ 39'-1" CONCRETE I BEAM BRIDGE
DETAILS OF SUPERSTRUCTURE

Across LAKE CREEK
Sta. 1183+00.00 to 1185+02.46
Co. GRANITE Sec. 23 T. 11 S. R. 80 W.

Designed by G.H.D.	Approved by [signature]
Made by G.H.D.	Bridge Engineer
Checked by W.R.M.	Date: July 1946



| STATE | F.A.S. |
| COLO. | S-423 (3) | 6-C |
NEW SHEET 8/3/46
REVISED CONSTRUCTION DIVISIONS 9-20-46 G.H.D.
COMBINED " " 4-14-47 JFK
PLAN OF ABUTMENTS
LAYOUT OF LONGITUDINAL FOOTING STEEL
ELEVATION OF ABUTMENTS
SECTION A-A
TRUE ELEVATION OF WINGS
SECTION B-B
EXPANSION
FIXED
1¾" Parabolic Crown
Timber Header
See True Elevation for Reinforcing
3" Diam. Weep Holes
7" Spacing for A bars
7" Spacing for B bars
Abut.#1 Elev. 9156.59
Abut.#4 Elev. 9156.49
MAX. TOE PRESSURE 2500 LBS SQ.FT.
Note:
General Layout, General Notes, Summary of Quantities and Details of Pier No 2 & 3 See Sheet No 6-A
Details of Superstructure See Sheet No 6-B
COLORADO
STATE HIGHWAY DEPARTMENT
3-SPANS AT 39'-1"
CONCRETE I-BEAM BRIDGE
DETAILS OF ABUTMENTS
Across Lake Creek
Designed by G.H.D.
Made by G.H.D.
Checked by G.H.M.
Approved by
Bridge Engineer
STRUCTURE NO. H-11-A

FED. ROAD DIST. NO.	STATE	PROJ. NO.	SHEET NO.	TOTAL SHEETS
3	COLO.	S 0132(1)	1	

Rev. 3-30-54, For Current "M" St'ds., J.C.R.

132.01

COLORADO
DEPARTMENT OF HIGHWAYS
PLAN AND PROFILE OF PROPOSED
FEDERAL AID PROJECT NO. S 0132(1)
STATE HIGHWAY NO. 300
LAKE COUNTY

INDEX OF SHEETS

SHEET NO.		
1	SKETCH MAP TITLE PAGE AND TABULATION OF LENGTH & DESIGN DATA.	
2	TYPICAL SECTION, GENERAL NOTES, SURFACING PLAN, R.O.W. MARKERS, TIMBER GUARD POSTS, & FENCING REQUIREMENTS	
3	SUMMARY OF APPROXIMATE QUANTITIES	
4	LIST OF STRUCTURES	
5	DETAILS OF BRIDGE STA. 45+	
6	STANDARD LETTERS & FIGURES FOR YEAR NUMBERS & STRUCTURE NUMBERS	M-10-B
7	STANDARD MARKER POSTS	M-7-C
8	STANDARD HEADWALLS AND APRONS FOR C.M.P. CULVERTS	M-102-G
9	REINFORCED CONCRETE CULVERT PIPE & CONCRETE SEWER PIPE	M-112-E
10	STANDARD END & ANGLE SECTIONS, & EXPANSION JOINTS FOR CONCRETE PIPE	M-118-A
11	STANDARD TIMBER GUARD POSTS	M-19-D
12	STANDARD WIRE FENCE WITH METAL POSTS	M-27-C
13	STANDARD METHODS FOR SUPERELEVATION & WIDENING OF CURVES	M-1-C
14	STANDARD SIDE APPROACH ROADS, FLARING, CUT SLOPE TREATMENT & WIDENING AT BRIDGES & AT CREST OF GRADES	M-2-EM
15	STANDARD ROADWAY CONSTRUCTION TRAFFIC SIGNS	M-29-A
16	STANDARD TYPES OF RAILROAD WARNING SIGNS	M-18-B
17	STANDARD TYPES OF DITCHES AND CONSTRUCTION METHODS	M-107-C
18-22	ALIGNMENT PLAN & PROFILE	
22	PIT LOCATION	
23-44	CROSS SECTIONS	
45	SUMMARY OF EARTHWORK QUANTITIES	
	ALTERNATE BID ITEMS	

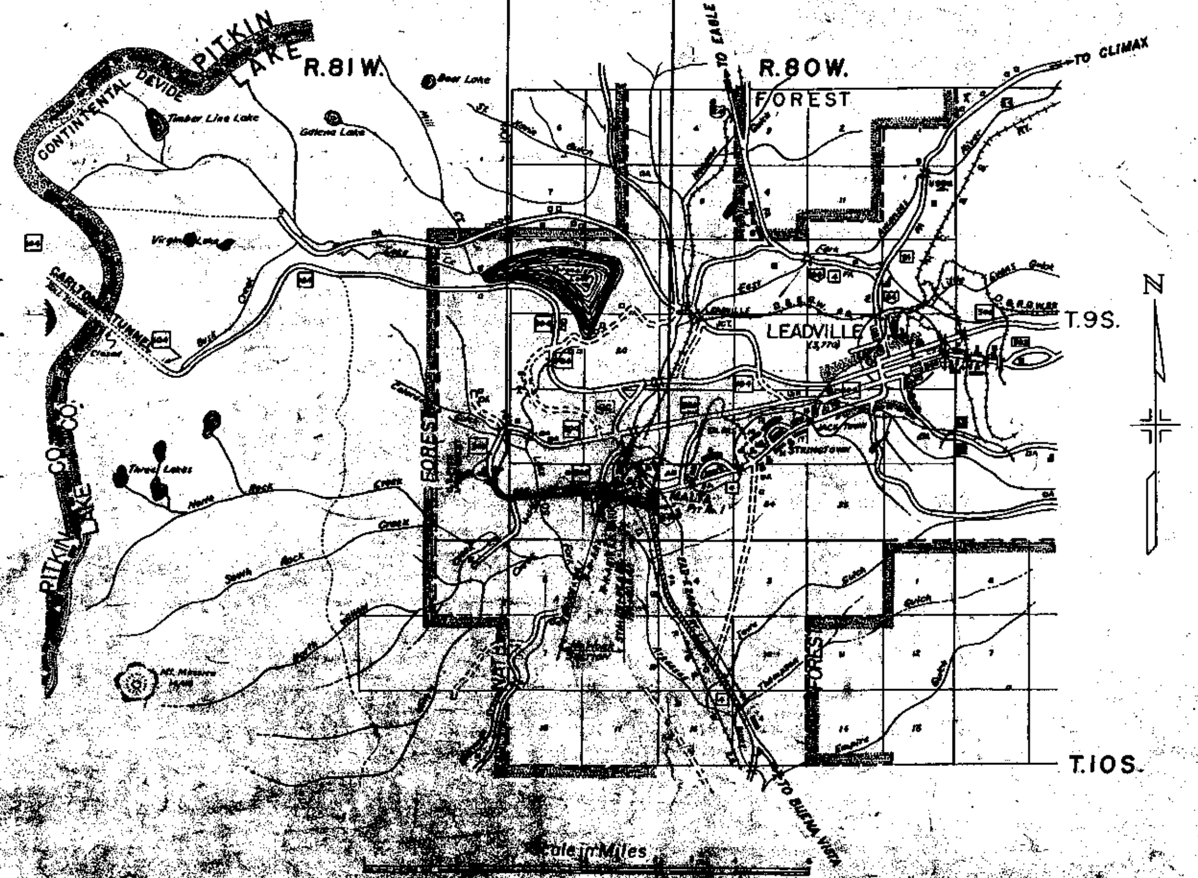
SCALE OF ORIGINAL TRACINGS
ON PLAN, 1 IN. - 100 FT.
ON PROFILE 1 IN. - 100 FT. HORIZONTAL; 1 IN. - 10 FT. VERTICAL
GRADE LINE ON PROFILE IS SHOWN AS GRADE OF FINISHED ROAD
GROSS LENGTH OF PROJECT 12,051.6 FEET = 2.282 MILES
NET LENGTH OF PROJECT 10,993.5 FEET = 2.082 MILES

CONVENTIONAL SIGNS

- CENTER LINE — Title Sheet
- RIGHT OF WAY LINE
- TOWNSHIP OR RANGE LINE
- SECTION LINE
- QUARTER SECTION LINE
- SIXTEENTH LINE
- PROPERTY OR TRACT LINE
- BARBED WIRE FENCE
- COMBINATION WIRE FENCE
- POLE FENCE
- PICKET FENCE
- SNOW FENCE
- RAILROAD
- POWER POLE LINES
- TELEP. & TELEG. POLE LINES
- PRESENT ROAD

STA. 10+00 = BEGIN S 0132(1)

STA. 145+70.0 = END S 0132(1)
OPP. STA. 193+09.6 on F.A.P. E 248-E



TABULATION OF LENGTH & DESIGN DATA

STATION	DESCRIPTION	ROADWAY LIN. FT.	MAJOR STRUCTURE LIN. FT.	MAJOR STRUCTURE LOADING
10+00	BEGIN S 0132(1)			
22+27.38 Bk. 22+27.9 Ah.	EQUA.	1227.3		
44+90	Bridge End	2262.1		
	Lake Fork Creek		58.5	H-20-44
45+48.5	Bridge End			
		5975.6		
105+24.1	Begin No Work Section = Opp. 120+415 on F.A.S. 8A(1)	161.1		
	Str. No. H-11-AA Arkansas River		159.3	H-15-35
		580.7		
	Str. No. H-11-AB Calif. Gulch		24.1	H-15-35
		132.9		
131+00 Ah.	End No Work Section = End F.A.S. 8A(1)			
145+70	END S 0132(1) = Opp. Sta. 193+09.6 on FAP E248-E	1470.0		
	TOTALS WORK SECTION	10,933.0	58.5	
	TOTALS NO WORK SECTION	874.7	183.4	

NO WORK SECTION

SUMMARY	LIN. FT.	MILES
Roadway	[illegible]	2.071
Bridges	58.5	0.011
No Work Section	1,058.1	0.200
GROSS LENGTH OF PROJECT	12,051.6	[illegible]
NET LENGTH OF PROJECT	10,993.5	[illegible]

DESIGN DATA

Maximum Degree of Curve	8°00'
Maximum Grade	2.50%
Minimum N.P.S.D. — Horizontal	[illegible]
Minimum N.P.S.D. — Vertical	500'
Maximum Design Speed	50 M.P.H.

NOTICE TO BIDDERS

It is recommended that Bidders on this project go over the plan details with one of the following field representatives of the Department.
F. C. Hammond, Resident Engineer, Glenwood Springs, Colo.
Homer W. Gray, Construction Engineer, Grand Junction, Colo.

COLORADO
DEPARTMENT OF HIGHWAYS
APPROVED:
Mark U. Watson
CHIEF ENGINEER DATE

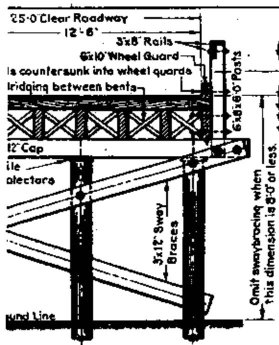
DEPARTMENT OF COMMERCE
BUREAU OF PUBLIC ROADS
APPROVED:
DISTRICT ENGINEER

Revised 6-27-52 for 1952 Specifications J.R.J.

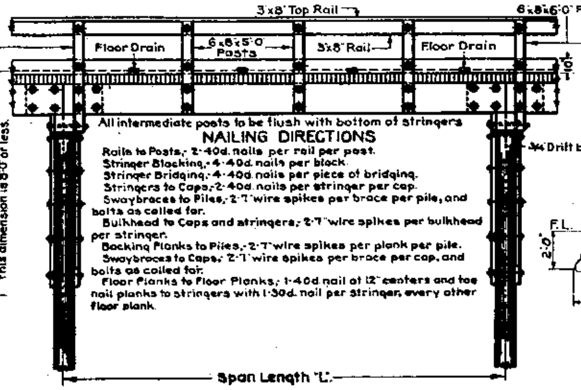
FED. ROAD DIVISION NO.	DISTRICT	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	50132(1)	5	

STANDARD P-118-BH

MODIFIED - Wings - Rip Rap added



HALF SECTION A-A
AL BENT AND SPAN SECTION

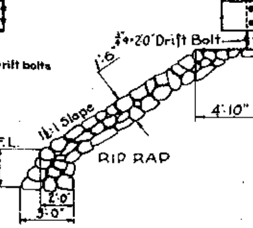


NAILING DIRECTIONS

All intermediate posts to be flush with bottom of stringers.

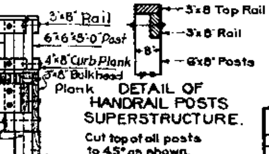
Rails to Posts, 2-40d. nails per rail per post.
Stringer Blocking, 4-40d. nails per block.
Stringer Bridging, 4-40d. nails per piece of bridging.
Stringers to Caps, 2-40d nails per stringer per cap.
Swaybraces to Piles, 2-7" wire spikes per brace per pile, and bolts as called for.
Bulkhead to Caps and stringers, 2-7" wire spikes per bulkhead per stringer.
Backing Planks to Piles, 2-7" wire spikes per plank per pile.
Swaybraces to Caps, 2-7" wire spikes per brace per cap, and bolts as called for.
Floor Planks to Floor Planks, 1-40d. nail at 12" centers and toe nail planks to stringers with 1-30d. nail per stringer, every other floor plank.

TYPICAL ELEVATION OF SPAN



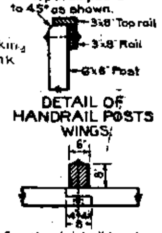
SECTION B-B.

See bill of material for number of backing planks required.



DETAIL OF HANDRAIL POSTS SUPERSTRUCTURE.

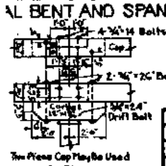
Cut top of all posts to 45° as shown.



DETAIL OF HANDRAIL POSTS WINGS.

Countersink bolt heads into wheel guards.

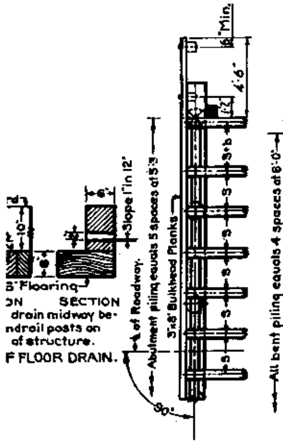
PLAN VIEW. DETAILS OF WHEEL GUARD SPLICE



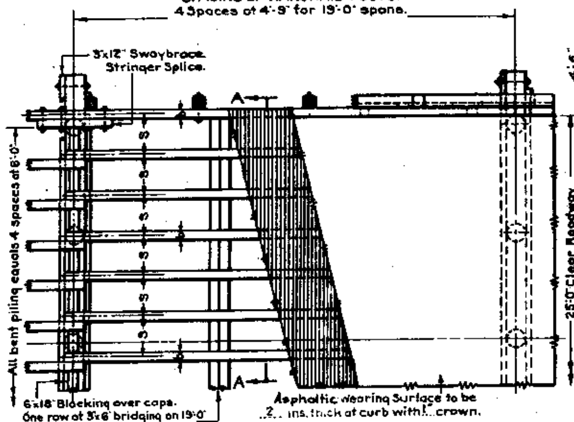
DETAIL OF CAP SPLICE

STRINGER SPACING				STRINGER BLOCKING		
L	S	S	NUMBER OF	ABUTMENTS		BENTS
SPAN LENGTH	SINGLE SPAN	MULTIPLE SPAN	STRINGERS	SINGLE SPAN	MULTIPLE SPAN	MULTIPLE SPAN
19'-0"	1'-3 5/16"	2'-3 1/4"	12	11 Pcs. 1'-9 1/4"	10 Pcs. 1'-9 1/4, 1 R. 2'-3 1/4"	11 Pcs. 1'-9 1/4"
~~23'-0"~~	~~[illegible]~~	~~[illegible]~~	~~12~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~
~~27'-0"~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~

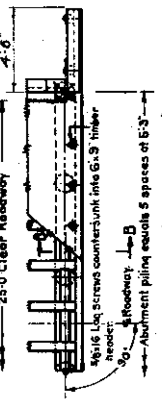
SPACING OF HANDRAIL POSTS.
4 Spaces of 4'-9" for 19'-0" spans.



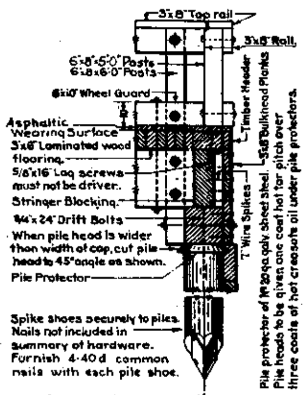
TIONAL HALF PLAN OF ABUTMENT



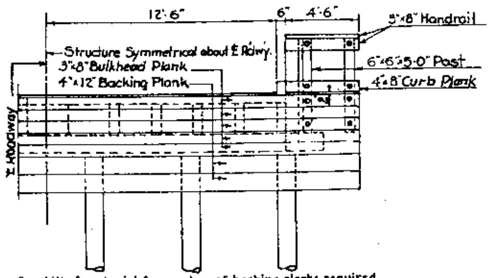
TYPICAL SECTIONAL HALF PLAN OF SPANS



HALF PLAN OF ABUTMENT



SECTION THRU ABUTMENT



See bill of material for number of backing planks required.

HALF END ELEVATION

NOTE: Flooring may be random lengths providing the joints are placed over the stringers and not closer than every third plank.

	INITIAL	DATE
	W.L.P.	8-10-53
	A.B.H.	6-14-53
	W.L.P.	8-10-63
	A.B.H.	8-14-53

IDARD P-118-BH.

GENERAL NOTES.

All work shall be done according to the Standard Specifications of The Colorado Department of Highways applicable to the project.

All timber and piling to be treated or untreated as shown in bills of material.

All timber and piling shall be dense southern yellow pine or west coast douglas fir.

All caps shall be edged to an even depth. The ends of all stringers shall be dapped on one edge to obtain an even depth over caps.

All cut surfaces or bored holes in treated timber or piles shall be thoroly saturated with hot creosote oil.

All piling supporting caps shall be covered with galvanized pile protectors as specified, all other piling tops shall be saturated with hot creosote oil and covered with a thick layer of heavy asphalt or tar.

Joints in top handrail must be staggered with joints in side rail.

All handrailing and posts above the wheel guards shall be painted white and all handrail posts below the top of wheel guards shall be painted black as specified.

All bolts more than 12" long must be threaded not less than 4 inches.

Bolts in the finished structure shall not project more than one half inch beyond the nut.

All bolts must have Std. C.I.O.G. or Malleable Cast Washers under each head and nut.

Bolt lengths are calculated assuming Std. C.I.O.G. washers will be used.

The contractor is cautioned to check bolt lengths before ordering because of variations in thickness of lumber and piling.

The entire exposed surface of all untreated timber shall be painted one coat as specified imediately after the material is delivered to the project.

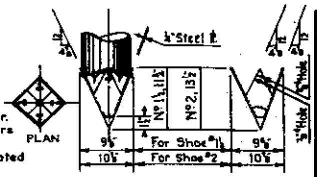
Before placing handrailing the contact surfacing shall receive the second coat of paint.

When contractor is permitted to drill holes to facilitate pile driving, these holes must be drilled so piling will stand in vertical position after final driving.

All hardware except nails to be galvanized. Weights of hardware as shown are for ungalvanized material.

All necessary blocking for swaybracing shall be treated timber.

All caps must be surfaced on vertical grain face.



DETAIL OF PILE SHOE

Furnish American Pulley Co's. Pile Shoe or equivalent. Where pile shoes are specified use No 1½ shoe for pile tips 2-9" and No 2 shoe for pile tips > 9". Wt. No 1½ 8 lbs. Wt. No 2, 13½ lbs.

GENERAL NOTES (CONT)

Contractors' attention is called to Specifications covering Mechanical Tamping. Special care must be used to prevent deflection of Abutments and Wings by wedging action. Back fill in 6 in. earth layers shall be mechanically tamped beginning at the wall and proceeding outward.

Below channel elevation mechanically tamp uniformly on both sides. Above original ground line mechanically tamp out to 6 ft. from the wall. Rolling equipment shall not be used within 6 ft. of any wall.

BOLTS AND WASHERS FOR ONE SPAN OF SUPERSTRUCTURE

LOCATION	SIZE	19'-0" SPAN NO.	LENGTH	TOTAL	~~23'-0" SPAN~~ NO.	LENGTH	TOTAL	~~27'-0" SPAN~~ NO.	LENGTH	TOTAL
POSTS TO RAILS	5/8"	6	10"	7.0 LBS.	6	10"	7.0 LBS.	8	10"	9.0 LBS.
POSTS TO WHEEL GUARDS	3/4"	6	14"	12.7 LBS.	6	14"	12.7 LBS.	8	14"	17.0 LBS.
POSTS TO STRINGERS	3/4"	12	16"	28.3 LBS.	12	16"	28.3 LBS.	16	16"	42.0 LBS.
WHEEL GUARDS TO STRINGERS	3/4"	6	36"	29.0 LBS.	6	38"	30.0 LBS.	8	38"	40.0 LBS.
WASHERS - STD. C.I.O.G. 5/8 & 3/4"		12/48		69.0 LBS.	12/48		69.0 LBS.	16/64		92.0 LBS.
TOTAL WEIGHT				146.0 LBS.			147.0 LBS.			200.0 LBS.

BOLTS AND WASHERS FOR ONE ABUTMENT

LOCATION	ITEM	SIZE	NO.	LENGTH	WT. EACH	TOTAL WT.
POSTS TO RAILS	BOLTS	5/8"	2	10"	1.08 LBS.	2.2 LBS.
POST TO BULKHEAD TO CAP	BOLTS	5/8"	2	23"	2.15 LBS.	4.3 LBS.
POSTS TO STRINGERS	BOLTS	3/4"	4	16"	2.60 LBS.	10.4 LBS.
POSTS TO WHEEL GUARDS	BOLTS	3/4"	2	14"	2.12 LBS.	4.3 LBS.
WHEEL GUARDS TO STRINGERS	BOLTS	3/4"	2	38"	5.00 LBS.	10.0 LBS.
TIMBER HEADER TO STRINGERS	LAG SCREWS	5/8"	12	16"	1.36 LBS.	16.3 LBS.
POSTS TO BULKHEAD & CURB PLNK & HANDRL	BOLTS	5/8	12/4	11"/12"	1.16/1.24 LBS.	19.0 LBS.
WASHERS - STD. C.I.O.G.	WASHERS 5/8-3/4		52/16		0.75/1.25 LBS.	59.0 LBS.
CAP TO PILES	DRIFT BOLTS	3/4"	6	24"	3.00 LBS.	16.0 LBS.
TOTAL WEIGHT						144.0 LBS.

BOLTS AND WASHERS FOR ONE BENT

LOCATION	ITEM	SIZE	NO.	LENGTH	WT. EACH	TOTAL WT.
POSTS TO RAILS	BOLTS	5/8"	2	10"	1.08 LBS.	2.2 LBS.
POSTS TO WHEEL GUARDS	BOLTS	3/4"	2	14"	2.12 LBS.	4.3 LBS.
POSTS TO CAP WITHOUT SWAYS	BOLTS	5/8"	2	20"	1.90 LBS.	3.8 LBS.
WHEEL GUARDS TO STRINGERS	BOLTS	3/4"	2	38"	5.00 LBS.	10.0 LBS.
POSTS TO STRINGERS TO SPLICES	BOLTS	3/4	4	24"	3.32 LBS.	13.3 LBS.
SPLICES TO STRINGERS	BOLTS	5/8"	12	16"	1.57 LBS.	18.8 LBS.
POSTS TO CAP TO SWAYBRACES	BOLTS	5/8"	2	23"	2.15 LBS.	4.3 LBS.
SWAYBRACES TO CAP	BOLTS	5/8"	2	17"	1.66 LBS.	3.3 LBS.
SWAYBRACES TO PILES	BOLTS	5/8"	8	17"	1.66 LBS.	13.3 LBS.
SWAYBRACE TO PILE TO SWAYBRACE	BOLTS	5/8"	1	20"	1.90 LBS.	1.9 LBS.
					LBS.	LBS.
WASHERS - STD. C.I.O.G. NO SWAYS.	WASHERS 5/8-3/4"		32/16		0.75/1.25 LBS.	44.6 LBS.
WASHERS - STD. C.I.O.G. WITH SWAYS	WASHERS 5/8-3/4"		54/16		0.75/1.25 LBS.	60.5 LBS.
CAPS TO PILES	DRIFT BOLTS	3/4"	5	24"		15.0 LBS.
TOTAL WEIGHT - WITHOUT SWAYBRACES						112.0 LBS.
TOTAL WEIGHT - WITH SWAYBRACES						147.0 LBS.

NAILS

LOCATION	ITEM	19'-0" SPAN	~~23'-0" SPAN~~	~~27'-0" SPAN~~
ONE SPAN OF SUPERSTRUCTURE	30D. COMMON	25 LBS.	30 LBS.	35 LBS.
		LBS.	LBS.	LBS.
	40D. COMMON	135 LBS.	165 LBS.	155 LBS.
ONE ABUTMENT	40D. COMMON	6 LBS.	5 LBS.	5 LBS.
	7" WIRE SPIKES	24 LBS.	LBS.	LBS.
	40D. COMMON	1 LB.	1 LB.	1 LB.
	7" WIRE SPIKES	LBS.	LBS.	LBS.
ONE BENT	40D. COMMON	5 LBS.	5 LBS.	5 LBS.
	7" WIRE SPIKES	5 LBS.	LBS.	LBS.

SUMMARY OF HARDWARE

BOLTS AND WASHERS			
3 SPANS	AT	146 LBS. PER SPAN	438 LBS.
2 ABUTMENTS	AT	144 LBS. PER ABUTMENT	288 LBS.
	AT	LBS. PER	LBS.
2 BENTS WITH SWAYBRACES	AT	147 LBS. PER BENT	294 LBS.
TOTAL WEIGHT			1020 LBS.

NAILS: LOCATION	UNIT	30D. COMMON EACH	30D. COMMON TOTAL	EACH	TOTAL	40D. COMMON EACH	40D. COMMON TOTAL	7" WIRE SPIKES EACH	7" WIRE SPIKES TOTAL
3 SPANS	LBS.	25	75			135	405	—	—
2 ABUTMENTS	LBS.	—	—			6	12	24	48
	LBS.	—	—						
2 BENTS	LBS.	—	—			5	10	5	10
TOTAL WEIGHT	LBS.		75				427		58

SUMMARY OF QUANTITIES

STRUCTURAL EXCAVATION					
ITEM 14a DRY ROCK				5	CU.YDS.
ITEM 14b DRY COMMON				16	CU.YDS.
ITEM 14c WET ROCK				5	CU.YDS.
ITEM 14d WET COMMON				5	CU.YDS.
ITEM 16a STRUCTURE BACKFILL				11	CU.YDS.
ITEM 16c MECHANICAL TAMPING				5	HOURS
ITEM 42a UNTREATED BRIDGE TIMBER					
3 SPANS	AT	280	BD.FT. EACH =	840	BD.FT.
2 ABUTMENTS	AT	144	BD.FT. EACH =	288	BD.FT.
	AT		BD.FT. EACH =		BD.FT.
2 BENTS	AT	48	BD.FT. EACH =	96	BD.FT.
			TOTAL =	1224	BD.FT.
ITEM 42b TREATED BRIDGE TIMBER					
2 SPANS	AT	5828	BD.FT. EACH =	11656	BD.FT.
1 SPANS	AT	5819	BD.FT. EACH =	5819	BD.FT.
2 ABUTMENTS	AT	1381	BD.FT. EACH =	2762	BD.FT.
	AT		BD.FT. EACH =		BD.FT.
2 BENTS	AT	756	BD.FT. EACH =	1512	BD.FT.
			TOTAL =	21749	BD.FT.
ITEM 60a PILING - TREATED					
2 ABUTMENTS	AT	132	LIN.FT. EACH =	264	LIN.FT.
	AT		LIN.FT. EACH =		LIN.FT.
2 BENTS	AT	110	LIN.FT. EACH =	220	LIN.FT.
			TOTAL =	484	LIN.FT.
ITEM 60e METAL PILE SHOES			See Detail	22	SHOES
ITEM 67a RIP RAP				56	CU.YDS.

▲ MATERIAL FURNISHED & WORK DONE BY STATE FORCES
FOR OVERHAUL ON STRUCTURE BACKFILL SEE PROJECT SUMMARY.

The preservative for all treated timber and piling shall be creosote oil.

ITEM 11a. REMOVAL OF BRIDGE	L.S.
ITEM 13C UNCLASSIFIED EXCAVATION	190 CU.YDS.

ONE SPAN OF SUPERSTRUCTURE

UNTREATED TIMBER										
DESCRIPTION	SIZE	19'-0" SPAN NO.	LENGTH	TOTAL	~~23'-0" SPAN~~ NO.	LENGTH	TOTAL	~~27'-0" SPAN~~ NO.	LENGTH	TOTAL
HANDRAILS S4S.	3"x8"	4	20'-0"	160 BD.FT.	4	24'-0"	192 BD.FT.	4	28'-0"	224 BD.FT.
HANDRAIL POSTS S4S	6"x8"	6	5'-0"	120 BD.FT.	6	5'-0"	120 BD.FT.	8	5'-0"	160 BD.FT.
TOTAL UNTREATED TIMBER				280 BD.FT.			312 BD.FT.			384 BD.FT.
TREATED TIMBER										
FLOORING *	3"x6"	87	26'-0"	3393 BD.FT.	105	26'-0"	4095 BD.FT.	124	26'-0"	4836 BD.FT.
BRIDGING	3"x6"	4	14'-0"	84 BD.FT.	8	14'-0"	168 BD.FT.	8	14'-0"	168 BD.FT.
WHEEL GUARDS ▼	6"x10"	2	20'-0"	200 BD.FT.	2	24'-0"	240 BD.FT.	2	28'-0"	280 BD.FT.
STRINGERS OUTSIDE INTERMEDIATE SPAN	6"x18"	2	19'-0"	342 BD.FT.						
	8"x20"				2	23'-0"	460 BD.FT.			
	8"x20"							2	27'-0"	720 BD.FT.
STRINGERS OUTSIDE END SPANS	6"x18"	2	19'-6"	351 BD.FT.						
	6"x20"				2	23'-6"	470 BD.FT.			
	8"x20"							2	27'-6"	734 BD.FT.
STRINGERS INSIDE INTERMEDIATE AND END SPANS	6"x18"	10	20'-0"	1800 BD.FT.						
	6"x20"				10	24'-0"	2400 BD.FT.			
	8"x20"							10	28'-0"	3734 BD.FT.
STRINGERS SINGLE SPAN	6"x18"	12	20'-0"	2160 BD.FT.						
	6"x20"				12	24'-0"	2880 BD.FT.			
	8"x20"							12	28'-0"	[illegible] BD.FT.
TOTAL TREATED TIMBER - SINGLE SPAN				5837 BD.FT.			7365 BD.FT.			9764 BD.FT.
TOTAL TREATED TIMBER - END SPAN				5828 BD.FT.			7373 BD.FT.			9752 BD.FT.
TOTAL TREATED TIMBER - INTER SPAN				5819 BD.FT.			7365 BD.FT.			9738 BD.FT.
ASPHALTIC WEARING SURFACE ▲				25 TONS			TONS			TONS

ONE ABUTMENT

UNTREATED TIMBER				
HANDRAIL POSTS S4S.		2/4 PCS.	6"x8"x6'-0" / 6"x6"x5'-0"	108 BD.FT.
HANDRAILS S4S		4 PCS.	3"x8"x4'-6"	36 BD.FT.
TREATED TIMBER \ TOTAL UNTR. TIMBER				144 BD.FT.
TIMBER HEADER		1 PC.	6"x9"x26'-0"	117 BD.FT.
CAP		1 PC.	12"x12"x30'-0"	360 BD.FT.
BULKHEAD PLANKS		5 PCS.	3"x12"x22'-0"	[illegible] BD.FT.
STRINGER BACKING		5 PCS.	[illegible]	[illegible] BD.FT.
STRINGER BLOCKING Cut before treatment	19' & 23' SPANS	1 PC.	6"x18"x22'-0"	198 BD.FT.
	~~27' SPANS~~			
CURB PLANK		2 PC.	4"x8"x4'-6"	24 BD.FT.
BACKING PLANK		2 PC.	4"x12"x22'-0"	176 BD.FT.
BACKING PLANK		2 PC.	4"x12"x16'-0"	128 BD.FT.
TOTAL TREATED TIMBER				1381 BD.FT.
PILING TREATED		6 PCS. @ 22'-0" LINEAL FT. EACH		132 LIN.FT.

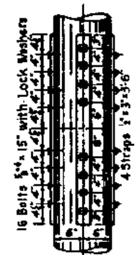
ONE BENT

UNTREATED TIMBER				
HANDRAIL POSTS S4S.		2 PCS.	6"x8"x6'-0"	48 BD.FT.
TOTAL UNTREATED TIMBER				48 BD.FT.
TREATED TIMBER				
STRINGER SPLICES		2 PCS.	6"x18"x4'-0"	72 BD.FT.
CAP		1 PC.	12"x12"x30'-0"	360 BD.FT.
SWAYBRACES		2 PCS.	3"x12"x30'-0"	180 BD.FT.
STRINGER BLOCKING Cut before treatment	19' & 23' SPANS	1 PC.	6"x18"x16'-0"	144 BD.FT.
	~~27' SPANS~~	~~1 PC.~~	~~6"x18"x12'-0"~~	BD.FT.
~~SHIMS~~		~~12 PCS.~~	~~2"x6"x1'-0"~~	BD.FT.
				BD.FT.
TOTAL TREATED TIMBER				756 BD.FT.
PILING - TREATED		5 PIECES AT 22'-0" LINEAL FT. EACH		110 LIN.FT.

★ 50% S2S - 50% S2S, 1E ¼" off

▼ Lengths of Wheel Guards

SPANS	19'-0"	~~23'-0"~~	~~27'-0"~~
SINGLE	~~19'-0"~~	~~23'-0"~~	~~27'-0"~~
END	18'-7"	~~22'-7"~~	~~26'-7"~~
END	20'-0"	~~24'-0"~~	~~28'-0"~~
INTERMEDIATE	19'-8"	~~23'-8"~~	~~27'-8"~~



PILE SPLICE
Bolts and Straps Galv.
Note: Bolt length given for 12" dia. Pile.

Note 32) Drive nails to be installed by Engineering forces.

STRUCTURES REQUIRED
Asphaltic 3 SPANS AT 19'-0"
▲ Surface to extend 10 ft. beyond each abutment.

LOADING DATA.
LIVE LOAD - A.A.S.H.O. 1944 H-20-44
DEAD LOAD - Assumes 25 lbs. per sq. ft. additional wearing surface. This includes asphaltic wearing surface. No impact for 180° lbs. per sq. ft.

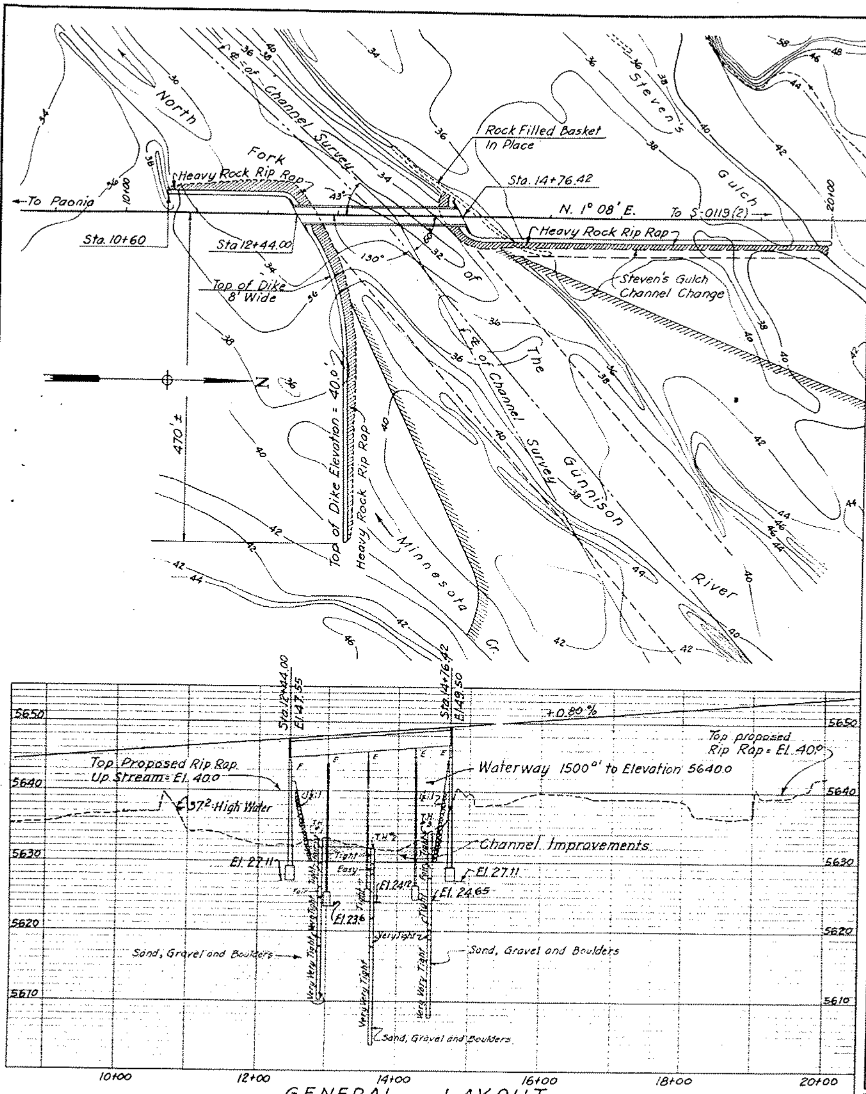
COLORADO DEPARTMENT OF HIGHWAYS
TREATED TIMBER PILE TRESTLE WITH 6" LAMINATED WOOD FLOOR & ASPHALTIC WEARING SURFACE
25 FT. CLEAR ROADWAY
Across LAKE FORK CREEK
Sta. 44+90.0 to 45+48.5
Near MALTA Sec 31 T.9S R.80W

Designed by MFM	Approved by [signature]
Made by H65 A.G.H.	Bridge Engineer
Check Design HWP	Date: May 1, 1959
Check Detail HWP	

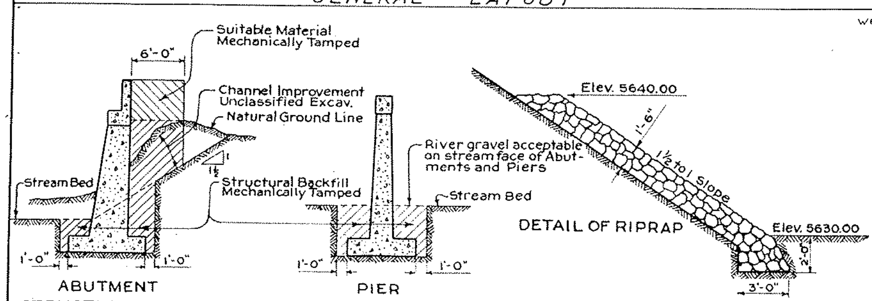
STRUCTURE NO. H-11-U

OF HIGHWAYS
138
500
LACING
LOADING DATA
ERAL NOTES

Initial	Date
P.C.	7-23-54
P.C.	7-23-54
T.J.M.	8-23-54
A.E.S.	10-29-54



GENERAL LAYOUT



ABUTMENT

PIER

DETAIL OF RIPRAP

STRUCTURE BACKFILL & MECHANICAL TAMPING DIAGRAMS

All material that is to be mechanically tamped, shall be placed in horizontal layers not more than 6 inches in depth and tamped before the next layer is placed.

BAR LIST SUPERSTRUCTURE

LWF / AES

MARK	SIZE	NO. REQD.	LENGTH	TYPE	DIMENSIONS ℓ	m	n
460	½"φ	122	26'-8"	Str.			
461	½"φ	12	27'-8"	Str.			
462	½"φ	268	31'-10"	Str.			
463	½"φ	122	26'-0"	Str.			
464	½"φ	12	27'-0"	Str.			
465	½"φ	96	4'-5"	I	1'-2½"	0'-8"	
466	½"φ	14	2'-11"	Str.			
525	⅝"φ	342	38'-10"	Str.			
526	⅝"φ	169	40'-1"	VII			
527	⅝"φ	400	4'-7"	VIII			
615	¾"φ	8	10'-1"	III	4'-6"	1'-1"	

BAR SUMMARY SUPERSTRUCTURE

16,078 Lin. Ft. ½"φ bar @ 0.668#/lin. ft. = 10,740 lbs.
21,888 " " ⅝"φ bar @ 1.043#/ " " = 22,829 "
81 " " ¾"φ bar @ 1.502#/ " " = 122 "
1% ± for Overrun = 334 "
Total = 34,025 "

BAR LIST PIER No. 2 (Same for 3 & 4)

P.C. / AES

MARK	SIZE	NO. REQD.	LENGTH	TYPE	DIMENSIONS ℓ	m	n
415	½"φ	1	15'-8"	Str.			
416 to 427	do	1 ea.	7'-1" by 2" to 8'-11"	I	1'-7¼" by ½" to 2'-0¾"	1'-7¼" by ½" to 2'-0¾"	
428 to 439	do	1 ea.	7'-9" by 2¼" to 9'-9¼"	V	1'-7¼" by ½" to 2'-0¾"	1'-7¼" by ½" to 2'-0¾"	
440	do	18	22'-6"	Str.			
441	do	20	17'-2"	III	0'-8"	8'-3"	
442	do	74	10'-1½"	I	1'-2¾"	3'-6"	
605	¾"φ	36	6'-9"	Str.			
606	do	6	11'-0"	IV	2'-0"	4'-6"	
905	1⅛"φ	4	5'-8"	Str.			
906	do	4	13'-1"	Str.			
1010	1¼"φ	3	10'-6"	Str.			
1011	do	6	11'-6"	Str.			
1012	do	8	36'-6"	Str.			
1101	1⅜"φ	8	18'-0"	Str.			

* BAR SUMMARY PIER No. 2

A.E.S. / D.S.M.

1714 Lin. Ft. ½"φ bar @ 0.668#/lin. ft. = 1145 lbs.
309 " " ¾"φ " @ 1.502#/ " " = 464 "
75 " " 1⅛"φ " @ 3.400#/ " " = 255 "
393 " " 1¼"φ " @ 4.303#/ " " = 1691 "
144 " " 1⅜"φ " @ 5.313#/ " " = 765 "
1% ± for Overrun = 45 "
Total = 4365 "

* Same for Piers No. 3 & 4

BAR LIST ABUT. No. 1

P.C. / AES

MARK	SIZE	NO. REQD.	LENGTH	TYPE	DIMENSIONS ℓ	m	n
401	½"φ	8	11'-4"	I	1'-8"	3'-8"	
402	do	12	9'-10"	I	1'-8"	2'-11"	
403	do	4	8'-4"	I	1'-8"	2'-2"	
404	do	41	15'-8"	II	2'-6½"		
405	do	4	19'-1"	II	4'-3"		
406	do	4	18'-9"	II	4'-1"		
407	do	12	26'-0"	Str.			
408	do	16	3'-0"	Str.			
409	do	2	8'-6"	III	0'-8"	3'-11"	
410	do	2	10'-6"	III	0'-8"	4'-11"	
501	⅝"φ	16	3'-10"	Str.			
502	do	34	5'-6"	Str.			
503	do	4	5'-2"	Str.			
504	do	4	11'-0"	Str.			
505	do	8	16'-0"	Str.			
601	¾"φ	24	10'-0"	Str.			
602	do	6	8'-8"	IV	2'-0"	3'-4"	
603	do	2	47'-2"	Str.			
901	1⅛"φ	4	10'-10"	Str.			
902	do	6	16'-0"	Str.			
1001	1¼"φ	4	9'-0"	Str.			
1002	do	4	12'-0"	Str.			
1003	do	2	9'-6"	Str.			
1004	do	2	15'-6"	Str.			
1005	do	4	47'-2"	Str.			

BAR SUMMARY ABUT. No. 1

A.E.S. / D.S.M.

1434 Lin. Ft. ½"φ bar @ 0.668#/lin. ft. = 958 lbs.
441 " " ⅝"φ " @ 1.043#/ " " = 460 "
386 " " ¾"φ " @ 1.502#/ " " = 580 "
139 " " 1⅛"φ " @ 3.400#/ " " = 473 "
323 " " 1¼"φ " @ 4.303#/ " " = 1390 "
1% ± for Overrun = 39 "
Total = 3900 "

BAR LIST ABUT. No. 5

P.C. / AES

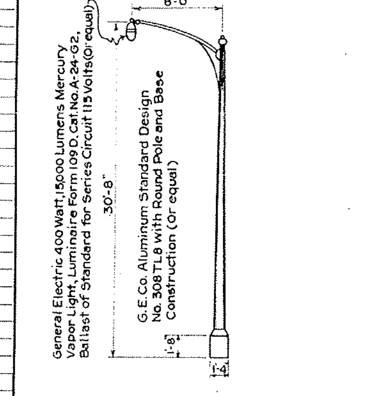
MARK	SIZE	NO. REQD.	LENGTH	TYPE	DIMENSIONS ℓ	m	n
445	½"φ	6	11'-10"	I	1'-8"	3'-11"	
446	do	12	10'-4"	I	1'-8"	3'-2"	
447	do	8	8'-4"	I	1'-8"	2'-2"	
448	do	35	19'-3"	VI			
449	do	7	20'-7"	II	5'-0"		
450	do	7	21'-1"	II	5'-3"		
451	do	8	3'-0"	Str.			
452	do	2	10'-6"	III	0'-8"	4'-11"	
453	do	2	12'-6"	III	0'-8"	5'-11"	
454	do	2	24'-9"	Str.			
455	do	12	26'-0"	Str.			
456	do	2	7'-3"	Str.			
457	do	2	6'-9"	Str.			
520	⅝"φ	42	5'-6"	Str.			
521	do	4	4'-2"	Str.			
522	do	4	10'-0"	Str.			
523	do	8	17'-0"	Str.			
610	¾"φ	16	4'-3"	Str.			
611	do	6	8'-8"	IV	2'-0"	3'-4"	
612	do	2	47'-2"	Str.			
701	⅞"φ	24	11'-2"	Str.			
910	1⅛"φ	4	7'-10"	Str.			
911	do	4	13'-3"	Str.			
912	do	6	17'-0"	Str.			
1015	1¼"φ	4	9'-0"	Str.			
1016	do	4	12'-0"	Str.			
1017	do	2	9'-6"	Str.			
1018	do	2	15'-6"	Str.			
1019	do	4	47'-2"	Str.			

BAR SUMMARY ABUT. No. 5

A.E.S. / D.S.M.

1687 Lin. Ft. ½"φ bar @ 0.668#/lin. ft. = 1127 lbs.
924 " " ⅝"φ " @ 1.043#/ " " = 442 "
214 " " ¾"φ " @ 1.502#/ " " = 321 "
268 " " ⅞"φ " @ 2.044#/ " " = 548 "
186 " " 1⅛"φ " @ 3.400#/ " " = 632 "
323 " " 1¼"φ " @ 4.303#/ " " = 1390 "
1% ± for Overrun = 45 "
Total = 4505 "

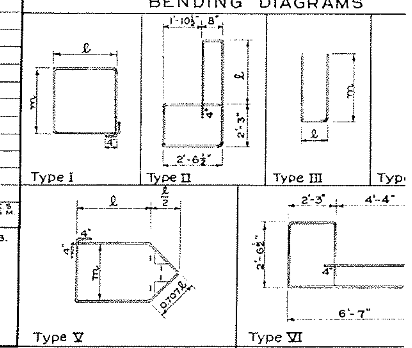
FED. ROAD DIV. NO.	DISTRICT	PROJECT NO.	SHEET NO.
9	COLO.	S 0119-(11)	7

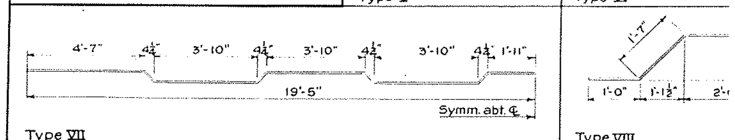


LIGHT STANDARD

Place 2 Light Standards on superstructure as shown on Sheet No. 8

* BENDING DIAGRAMS





* All bar dimensions are out to out of bar.

SUMMARY OF QUANTITIES

W.E.J. / A.E.S.

	ITEM	DESCRIPTION	UNIT	SUPERSTR	ABUT. 1	PIER 2	PIER 3	PIER 4	ABUT. 5	TOTAL
	13 c	Unclassified Excavation	Cu. Yd.							
	14 a	Dry Rock Excavation (Str.)	Cu. Yd.							5
	14 b	Dry Common Excavation (Str.)	Cu. Yd.		9				12	21
	14 c	Wet Rock Excavation (Str.)	Cu. Yd.							5
	14 d	Wet Common Excavation (Str.)	Cu. Yd.		21	39	32	35	23	150
	16 a	Structure Backfill (Class I)	Cu. Yd.		18	33	30	34	42	157
	16 c	Mechanical Tamping	Hour		14	3	4	4	12	37
	18 a	Sta. Yd. Overhaul	Sta. Yd.							
	18 b	Yd. Mi. Overhaul	Yd. Mi.							
	42 a	Untreated Bridge Timber	Mft. bm							.323
⊙	46 a	Class "A" Concrete	Cu. Yd.	222.4	35.8	31.8	31.8	31.8	40.4	394.0
	47	Reinforcing Steel	Lb.	34,025	3,900	4,365	4,365	4,365	4,505	55,525
†	48	Structural Steel (½% added for paint)	Lb.	200,184	578	268	268	268	578	202,144
	67 b	Heavy Riprap	Cu. Yd.							815
	80 c	Sheet Copper	Lb.			1.2	1.2	1.2		3.6
	89	Drain Pipe (Conc. Floor) 4"φ x 2'-0"	Each	8						8
	90	1½" Electrical Conduit with Junct. Boxes	Lin. Ft.	238						238
*		½" Expansion Joint Material	Sq. Ft.		4					4
*		¼" Expansion Joint Material	Sq. Ft.			30	30	30		90
	98 a	Light Standards complete with Base	Ea.	2						2
	98 c	Highway Luminaires	Ea.	2						2

⊙ Includes Class "A" Concrete Support for Lighting Standards.
† Includes 18,940 lbs. of Steel Handrailing.
* All Expansion Joint Material to be Type I, A.A.S.H.O., M 153-52 and to be included in the Bid Price for Class "A" Concrete.

GENERAL NOTES

ALL WORK SHALL BE DONE ACCORDING TO THE STANDARD SPECIFICATIONS OF THE COLORADO DEPARTMENT OF HIGHWAYS APPLICABLE TO THE PROJECT.

ALL CONCRETE SHALL BE CLASS "A" AND AIR ENTRAINED AS SPECIFIED.

ALL CONCRETE SURFACES EXPOSED TO VIEW SHALL RECEIVE CLASS "I" SURFACE FINISH, EXCEPT THE UNDERSIDE OF FLOOR SLABS AND ABUTMENT FACES BETWEEN OUTSIDE STRINGERS.

CONCRETE GIRDERS, FLOOR SLABS, AND CURBS SHALL BE POURED MONOLITHICALLY.

FORMS FOR CONCRETE SURFACES EXPOSED IN THE FINISHED WORK SHALL BE CONSTRUCTED OF SHIPLAP OR TONGUE AND GROOVE LUMBER S 3 S UNLESS FACED WITH PANEL BOARD.

FOOTINGS IN ROCK SHALL BE POURED OUT TO ROCK AND NOT FORMED.

SOUNDINGS AND DEPTH OF FOOTING SHOWN ARE IN ACCORDANCE WITH THE BEST AVAILABLE DATA AND WHEN DIFFERENT CONDITIONS ARE ENCOUNTERED THE BRIDGE ENGINEER WILL INSPECT AND DETERMINE IF REDESIGN IS NECESSARY.

ALL REINFORCING STEEL SHALL CONFORM TO ASTM SPECIFICATION A 305 50T OR THE LATEST REVISION THEREOF, AND SHALL BE INTERMEDIATE GRADE STEEL OF A DEFORMED TYPE. EACH BAR SHALL BE TAGGED WITH THE NUMBER DESIGNATION AND THE STATION NUMBER OF THE PROJECT. PRIMARY BARS SHALL NOT BE SPLICED AND SECONDARY BARS WHEN SPLICED SHALL LAP 20 DIAMETERS OF THE BAR. DIMENSIONS FOR REINFORCING STEEL NOT SHOWN AS CLEAR SHALL BE TO THE CENTER LINE OF THE BAR.

ALL STRUCTURAL STEEL SHALL BE PAINTED ONE SHOP COAT OF ZINC CHROMATE AND TWO FIELD COATS OF ALUMINUM, UNLESS OTHERWISE NOTED, EXCEPT THE UNEXPOSED PORTION OF STEEL PILING NEED NOT BE PAINTED.

HANDRAIL BOLTS SHALL HAVE HEX HEADS, NUTS AND LOCK WASHERS UNLESS OTHERWISE SPECIFIED AND ALL RIVETS EXCEPT AS NOTED ARE ⅞" DIA. AND SHALL BE POWER DRIVEN.

WHEN TREATED TIMBER OR PILING IS SHOWN ON THE DRAWING THE PRESERVATIVE FOR TREATMENT SHALL BE CREOSOTE OIL.

WHEN EXCAVATING FOR FOOTINGS THE FINAL ONE FOOT IN DEPTH SHALL BE DONE BY HAND LABOR METHODS.

HIGH STRENGTH BOLTS MAY BE USED IN PLACE OF FIELD RIVETS BUT AT NO ADDITIONAL EXPENSE TO THE STATE. THE BOLTS TO BE HIGH TENSILE AND SHALL BE ASSEMBLED IN ACCORDANCE WITH SPECIFICATIONS APPROVED BY THE RESEARCH COUNCIL ON RIVETED AND BOLTED STRUCTURAL JOINTS OF THE ENGINEERING FOUNDATION DATED JAN. 31, 1951.

STRUCTURE NO I-6-C

LOADING DATA

LIVE LOAD A.A.S.H.O. H-20-44
DEAD LOAD ASSUMES 15 LBS. PER SQ. FT. ADD. SURFACE WHICH INCLUDES THE ½ INCH CONC. WEARING SURFACE SHOWN.

DESIGNING DATA

A.A.S.H.O. 1953 UNIT STRESSES, EXCEPT AS N...

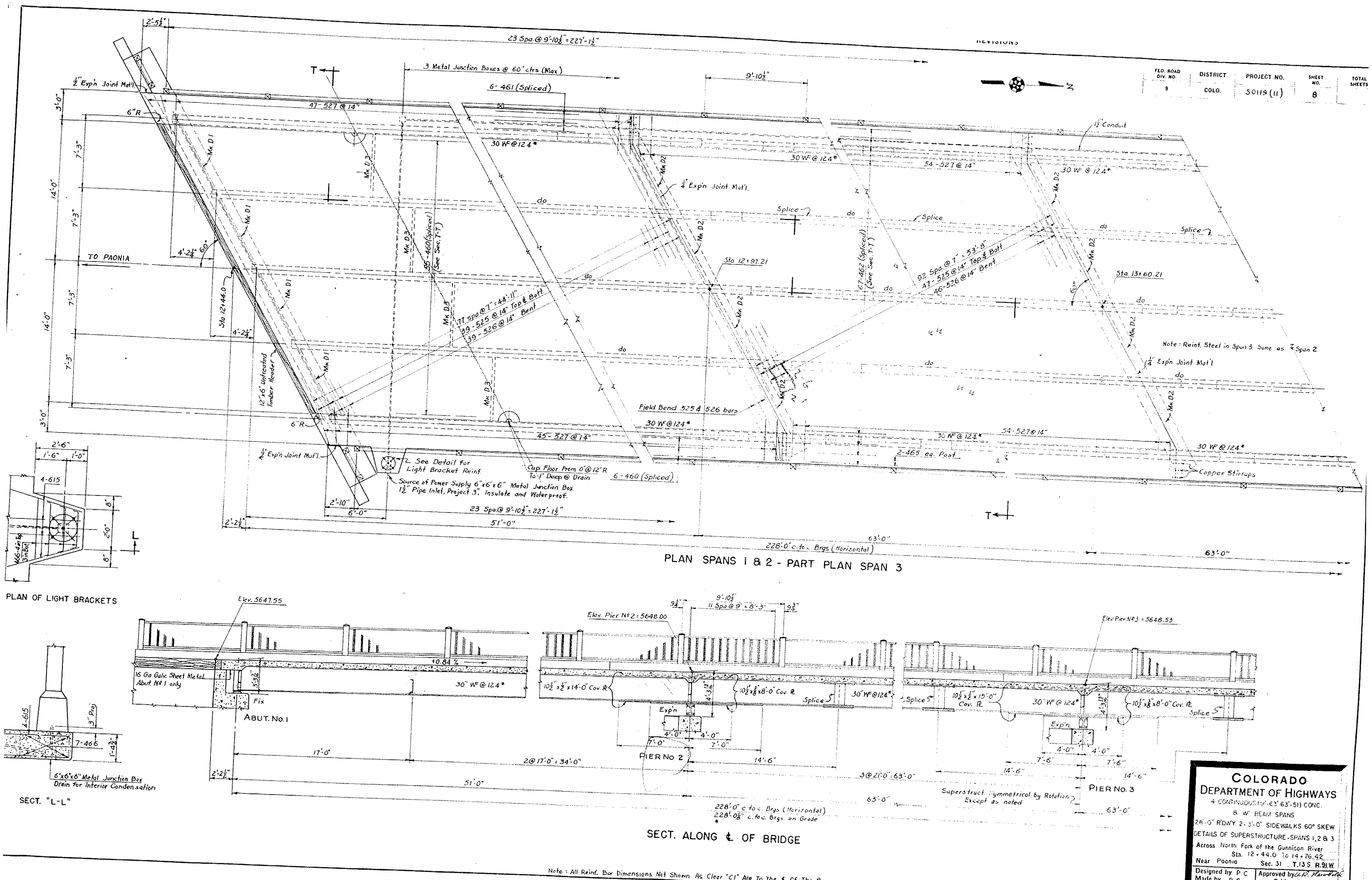
Reinforcing Steel fs 20000 lbs. per sq. in.
Structural Steel fs 18000 lbs. per sq. in.
fc 1000 lbs. per sq. in.
n 10

COLORADO
DEPARTMENT OF HIGHWAYS

4 CONTINUOUS (51', 63', 63' AND 51' ... AND WF BEAM SPANS, 60° SKEW, ... WAY, 2-3 FT. SIDEWALKS.
GENERAL LAYOUT, SUMMARY QUAN... BAR LIST AND DETAILS.

Across North Fork of Gunnison R...
Sta. 12+44.0 TO 14+76.4...
Near Paonia Sec. 31 T. ...

Designed by: P.C.	Approved by: [signature]
Made by P.C.	Bridge Eng...
Checked by: T.J.M.	Date: [handwritten]



COLORADO
DEPARTMENT OF HIGHWAYS

4 CONTINUOUS (51'-63'-63'-51') CONC.
8 WF BEAM SPANS
28'-0" R'DWY. 2 - 3'-0" SIDEWALKS 60° SKEW
DETAILS OF SUPERSTRUCTURE - SPANS 1, 2 & 3
Across North Fork of the Gunnison River
Sta. 12+44.0 to 14+76.42
Near Paonia — Sec. 31 T.13 S. R.91 W.

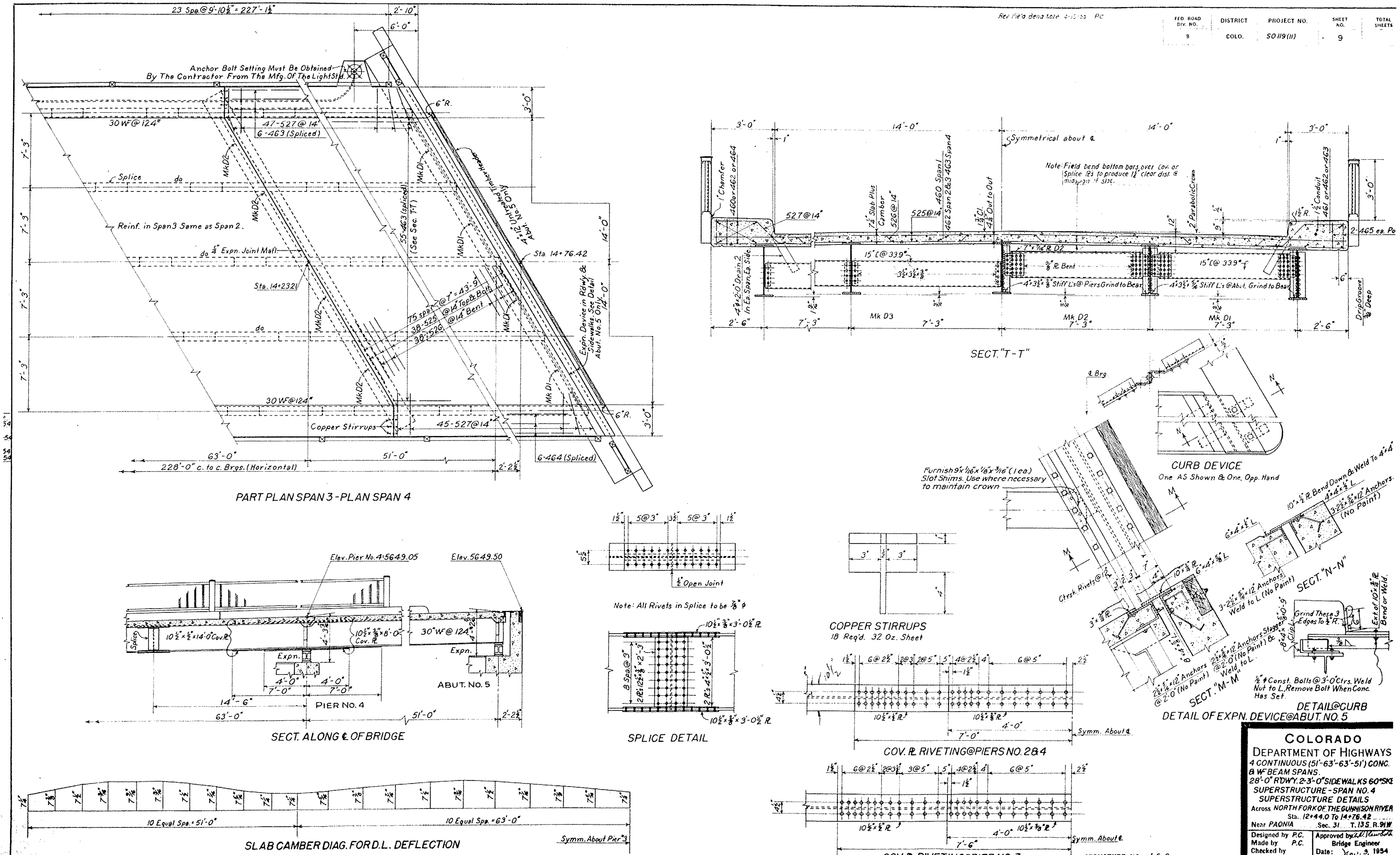
Designed by P.C.
Made by P.C.
Checked by

Approved by [signature]
Bridge Engineer
Date: Nov. 3, 1954

STRUCTURE NO. I-6-C

REVISIONS

FED. ROAD DIV. NO.	DISTRICT	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	S0119(11)	9	



Note: All Reinf. Bar Dimensions Not Given as Clear "Cl." Are To The ℄ of The Bar.

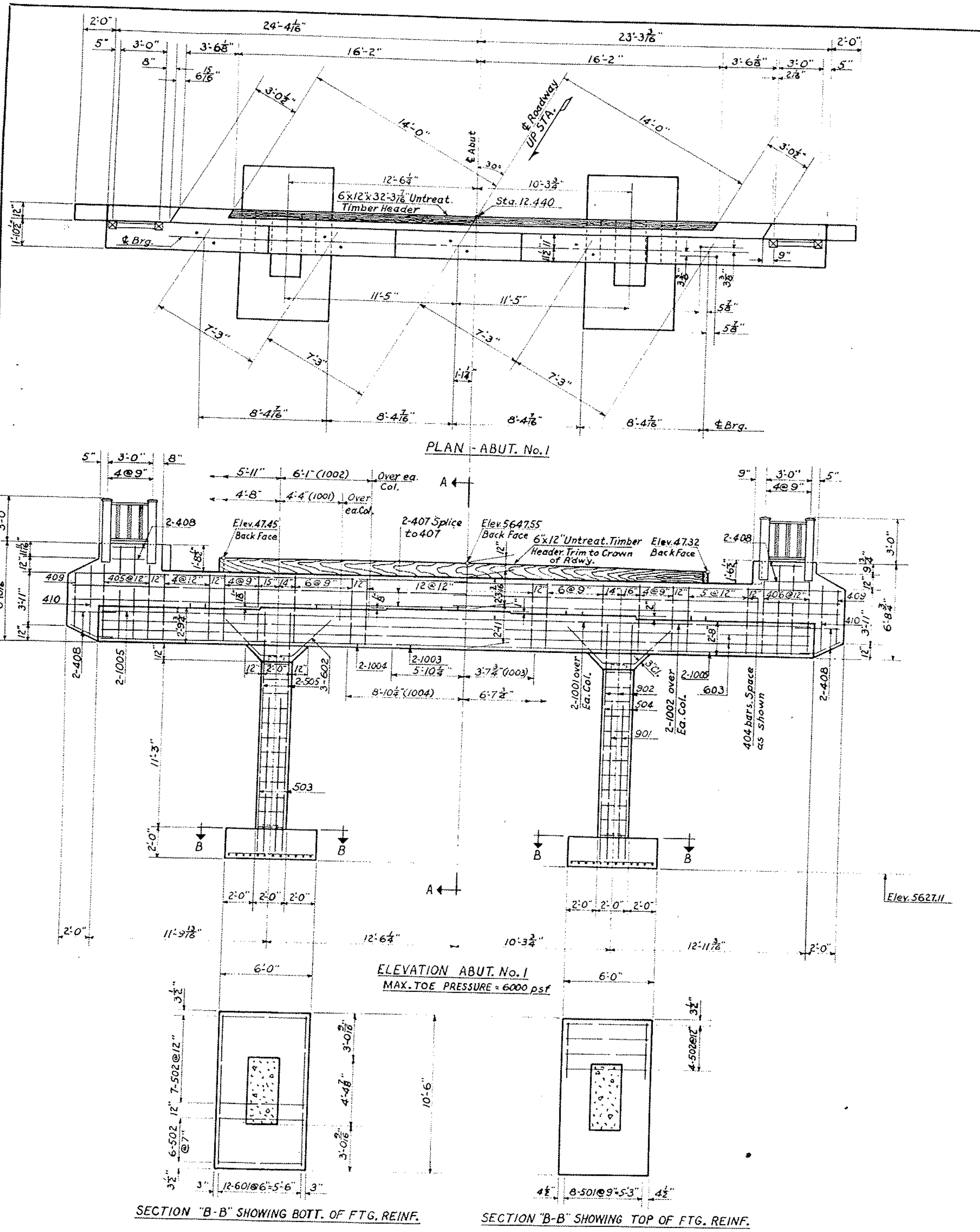
STRUCTURE NO. I-6-C

COLORADO
DEPARTMENT OF HIGHWAYS
4 CONTINUOUS (51'-63'-63'-51') CONC. & WF BEAM SPANS.
28'-0" RDWY. 2-3'-0" SIDEWALKS 60° SKE
SUPERSTRUCTURE - SPAN NO. 4
SUPERSTRUCTURE DETAILS
Across NORTH FORK OF THE GUNNISON RIVER
Sta. 12+44.0 To 14+76.42
Near PAONIA Sec. 31 T. 13 S. R. 91 W.

Designed by P.C.	Approved by
Made by P.C.	Bridge Engineer
Checked by	Date: 1954

FED. ROAD DIV. NO.	DISTRICT	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	S0119 (11)	10	

REVISIONS



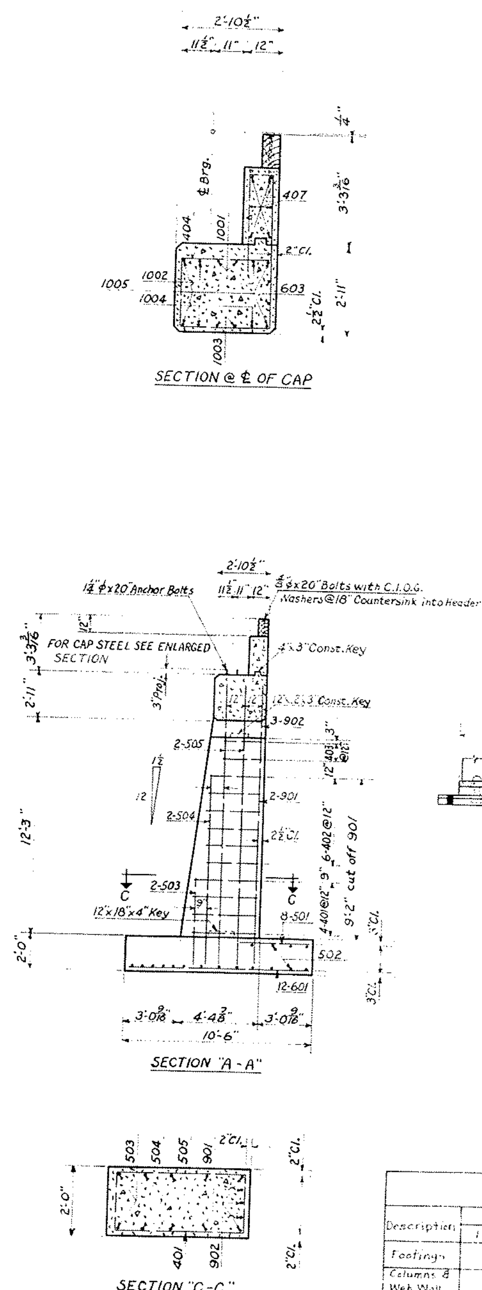
PLAN - ABUT. No. 1

ELEVATION ABUT. No. 1

MAX. TOE PRESSURE = 6000 psf

SECTION "B-B" SHOWING BOTT. OF FTG. REINF.

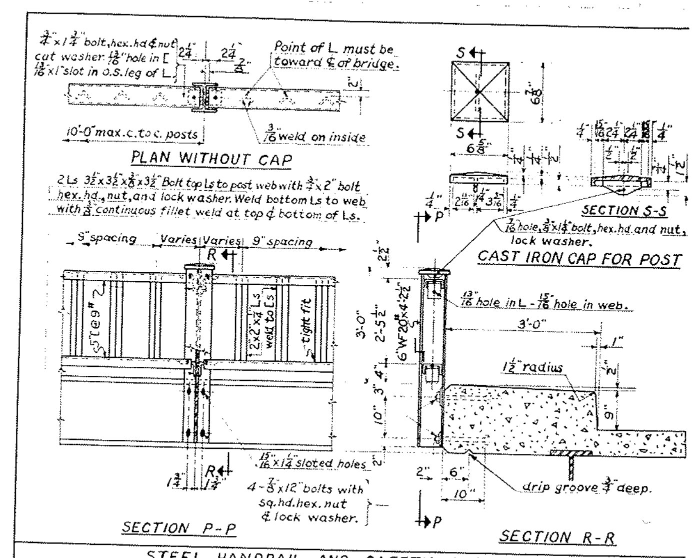
SECTION "B-B" SHOWING TOP OF FTG. REINF.



SECTION @ ℄ OF CAP

SECTION "A-A"

SECTION "C-C"



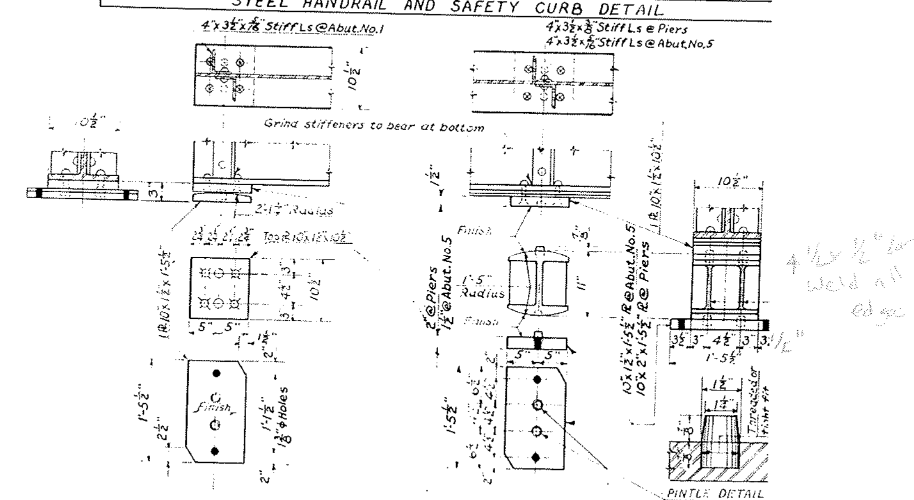
PLAN WITHOUT CAP

SECTION S-S

SECTION P-P

SECTION R-R

STEEL HANDRAIL AND SAFETY CURB DETAIL



FIXED BEARINGS

5 REQUIRED

EXPANSION BEARINGS

5 REQ'D. AT ABUT. No. 5 AS SHOWN

15 REQ'D. AT PIERS AS SHOWN

Furnish 2-1 1/4" φx20" Anchor Bolts Per Brg.

Coat Finished Contact Surfaces with Tallow ℄ White Lead.

POURING SCHEDULE

Description	Spans				Abuts.		Piers			Grand Total
	1	2	3	4	1	5	2	3	4	
Footings					9.4	10.4	7.8	7.8	7.8	
Columns & Web Wall					6.0	6.8	12.0	12.0	12.0	
Cap					15.4	15.1	12.0	12.0	12.0	
Parapet					5.0	8.1				
Total (Cu.Yd.)	51.0	60.2	60.2	51.0	35.8	40.4	31.8	31.8	31.8	394.0

COLORADO
DEPARTMENT OF HIGHWAYS

4 CONTINUOUS (51'-63'-63'-51') CONC. ℄ WF BEAM SPANS

28'-0" RDWY. 2-3'-0" SIDEWALKS 60° SKE

DETAILS OF ABUT. No. 1, HDRL. ℄ BRGS.

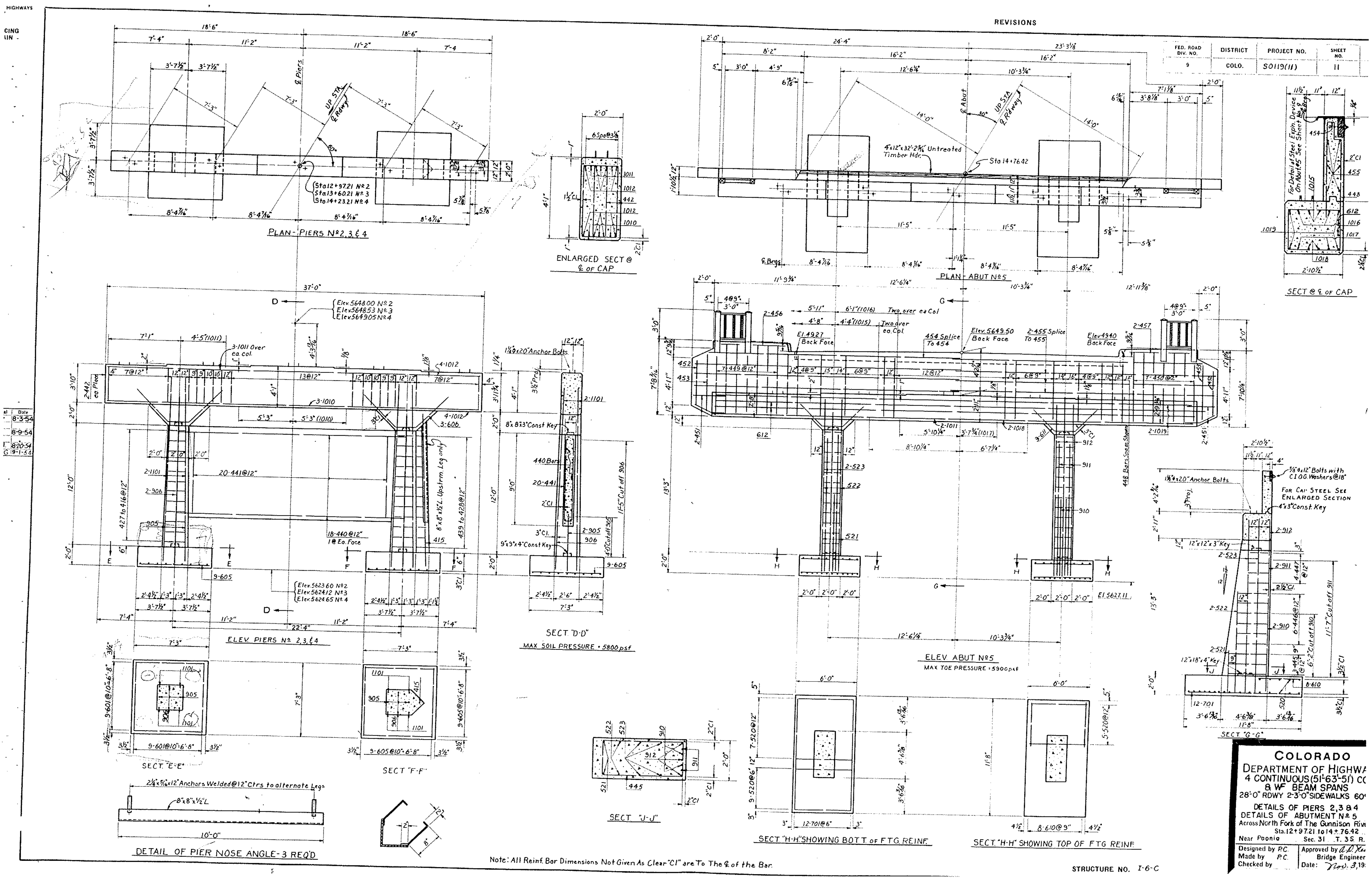
Across North Fork of The Gunnison River

Sta. 12+44.0 to 14+76.42

Near Paonia Sec. 31 T. 13S R 91 W

Designed by P.C.	Approved by [signature]
Made by P.C.	Bridge Engineer
Checked by	Date: ... 1954

Note: All Reinf. Bar Dimensions Not Shown As Clear "Cl." Are To The ℄ Of The Bar.



FED. ROAD DIV. NO.	DISTRICT	PROJECT NO.	SHEET NO.
9	COLO.	S0119(11)	11

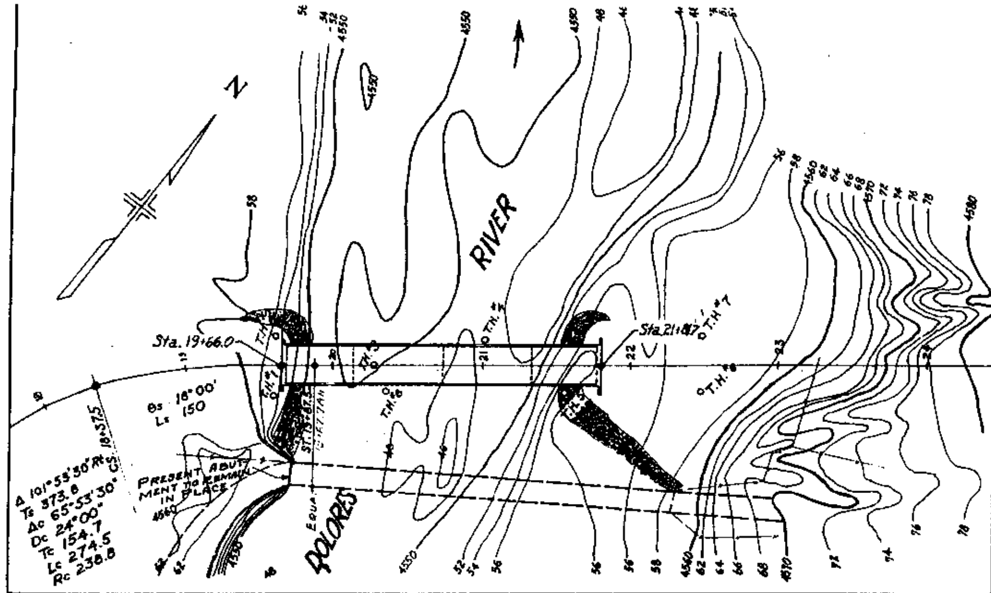
Note: All Reinf. Bar Dimensions Not Given As Clear "Cl" are To The ℄ of the Bar.

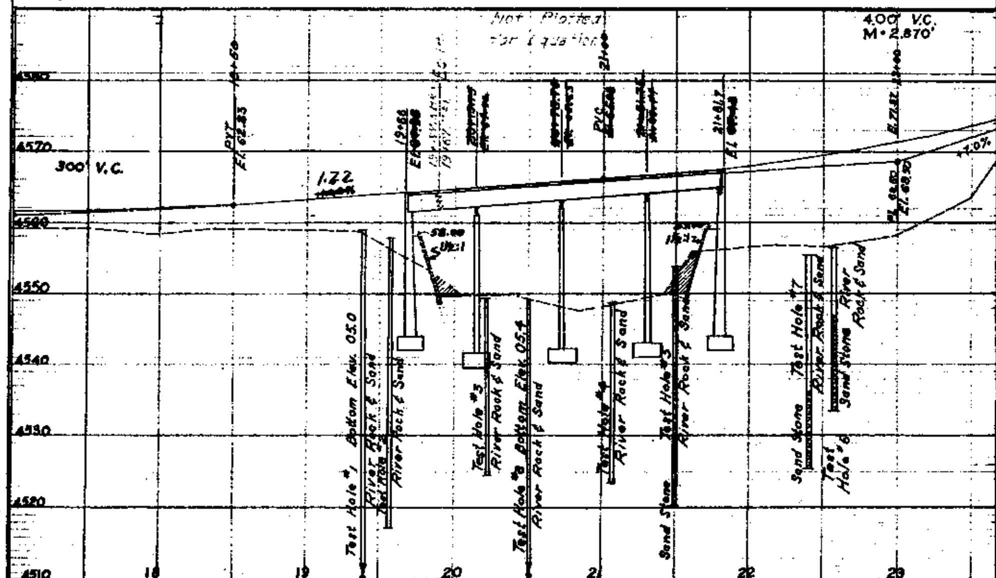
STRUCTURE NO. I-6-C

COLORADO
DEPARTMENT OF HIGHWA
4 CONTINUOUS (51'-63'-51') C
8 WF BEAM SPANS
28'-0" RDWY 2-3'-0" SIDEWALKS 60°
DETAILS OF PIERS 2, 3 & 4
DETAILS OF ABUTMENT Nº 5
Across North Fork of The Gunnison Riv
Sta. 12+97.21 to 14+76.42
Near Paonia Sec. 31 T. 3S R.

Designed by P.C. Approved by
Made by P.C. Bridge Engineer
Checked by Date: Nov. 3, 19

FED. ROAD DIV. NO.	STATE	PROJ. NO.	SHEET NO.
9	COLO.	A-AA 23(1)	4





BAR LIST ABUT. #1

No.	Size	No. Req'd	Length	Type	Dimension a	Dimension b
460	#4	12	5'-6"	Str.		
461	"	4	17'-0"	VII	6'-0"	4'-4"
462	"	48	14'-1"	VII	4'-6½"	2'-4½"
463	"	Not	Used.			
464	"	4	7'-3"		Field bend	
465	"	4	3'-9"	Str.		
466	"	14	8'-4"	IX	2'-2"	1'-8"
467	"	16	10'-8"	IX	3'-4"	1'-8"
469	"	18	7'-0"	Str.		
471	"	6	5'-0"	Str.		
472	"	Not	Used.			
473	"	6	33'-6"	Str.		
561	#5	14	5'-6"	Str.		
661	#6	8	5'-6"	Str.		
662	"	6	10'-0"	VI		
760	#7	24	3'-9"	Str.		
762	"	4	12'-0"	Str.		
763	"	4	6'-0"	Str.		
764	"	10	16'-6"	Str.		
766	"	8	8'-9	Str.		
768	"	16	9'-0"	Str.		
861	#8	8	33'-6"	Str.		
862	"	3	13'-6"	Str.		
863	"	6	9'-0"	Str.		

BAR LIST ABUT. #5

No.	Size	No. Req'd	Length	Type	Dimension a	Dimension b
440	#4	12	5'-6"	Str.		
441	"	6	18'-10"	VII	6'-11"	6'-3"
442	"	44	17'-4"	VIII	6'-2"	4'-6"
443	"	4	5'-9"	Str.		
444	"	4	5'-3"	Str.		
445	"	4	4'-9"	—	Field bend	
446	"	16	8'-4"	IX	2'-2"	1'-8"
447	"	16	11'-0"	IX	3'-6"	1'-8"
449	"	18	7'-6"	Str.		
451	"	6	5'-0"	Str.		
452	"	2	30'-0"	Str.		
453	"	8	33'-6"	Str.		
541	#5	14	5'-6"	Str.		
641	#6	12	5'-6"	Str.		
642	"	6	10'-0"	VI	4'-0"	2'-0"
741	#7	20	10'-6"	Str.		
840	#8	24	3'-9"	Str.		
841	"	8	33'-6"	Str.		
842	"	3	14'-0"	Str.		
843	"	6	9'-0"	Str.		
844	"	6	8'-9"	Str.		
846	"	10	18'-8"	Str.		
847	"	4	11'-9"	Str.		
848	"	4	6'-0"	Str.		

SUMMARY OF QUANTITIES

Item No.	Description	Unit	Super-Structure	Abut. 1	Pier 2	Pier 3	Pier 4	Abut. 5
1a	Removal of Existing Bridge	Lump Sum	—	—	—	—	—	—
13c	Unclassified Excavation	Cu. Yd.	—	83	—	—	—	27
14g	Common Excavation (Str.)	Cu. Yd.	—	43	27	21	23	48
16a	Structure Backfill (Class 1)	Cu. Yd.	—	43	27	21	23	48
16c	Mechanical Tamping	Hour	—	15	4	3	3	18
18a	Station Yard Overhaul	Sta. Yd.						
42b	Treated Bridge Timber	M.ft. bm.	0.288	0.096	0	0	0	.09
46a	Class "A" Concrete	Cu. Yd.	170	27	26	26	26	32
47	Reinforcing Steel (+1% for Overrun)	Lb.	25,180	3310	3,825	3825	3,825	400[illegible]
48 +	Structural Steel (+½% for Paint)	Lb.	159,793	20	364	364	364	2[illegible]
67a	Riprap	Cu. Yd.	0	65	0	0	0	95
75cx	Metal Plate Guard Rail (Beam Type)	Lin. Ft.	514	—	—	—	—	—
89a	Drain Pipe (Conc. Floor) (4"⌀ x 1'-6")	Each	8	—	—	—	—	—
*	½" Expansion Joint Mat'l. (Type I)	Sq. Ft.	0	4	16	16	16	0

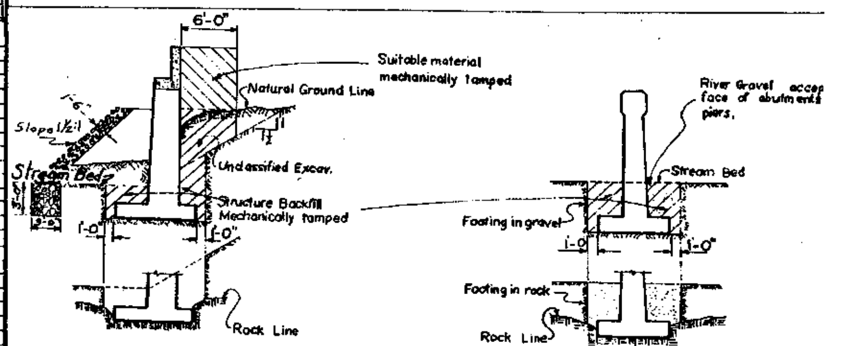
+ Structural Steel includes 4738 lbs Handrail Steel.
* Expansion Joint Material shall be included in the price bid for Class "A" Concrete and shall conform to A.A.S.H.O. Specification M-153-54

BAR LIST PIER No. 2 (PIER 3 & 4 Same)

No.	Size	No. Req'd	Length	Type	Dimension a	Dimension b
421	#4	1	3'-9"	dowel		
422	"	1	18'-6"	Str.		
423	"	32	14'-0"	Str.		
424	"	30	18'-0"	Str.		
425	"	6	8'-8"	III		
426	"	36	7'-9"	IX	1'-9"	1'-9"
427	"	82	7'-9"	IX	1'-2½"	2'-4½"
721	#7	28	6'-0"	Str.		
826	#8	4	27'-6"	Str.		
827	"	4	12'-0"	Str.		
921	#9	16	3'-9"	dowel		
922	"	8	18'-9"	Str.		
923	"	8	14'-3"	Str.		
925	"	8	8'-5"	Str.		
926	"	4	27'-6"	Str.		

BAR LIST SUPERSTRUCT.

No.	Size	No. Req'd	Length	Type	Dimension a	Dimension b
401	#4	57	28'-6"	Str.		
402	"	114	38'-6"	Str.		
403	"	57	38'-6"	Str.		
404	"	228	20'-0"	Str.		
405	"	284	3'-7"	II		
406	"	144	1'-0"	Str.		
501	#5	160	27'-9"	I		
502	"	320	26'-6"	Str.		



STRUCTURE BACKFILL & MECHANICAL TAMPING DIAGRAM

BAR SUMMARY ABUT. #1

Size	Lin. ft.	lbs/ft.	lbs
#4	1498	0.668	1000
5	77	1.043	80
6	104	1.502	156
7	524	2.044	1071
8	363	2.670	969
9	—	—	—
	Subtotal		3277
+1% for overrun			33
		TOTAL	3310

BAR SUMMARY ABUT. #5

Size	Lin. ft.	lbs/ft.	lbs
#4	1829	0.668	1222
5	77	1.043	80
6	126	1.502	189
7	210	2.044	429
8	765	2.670	2043
9	—	—	—
	Subtotal		3963
+1% for overrun.			37
		TOTAL	4000

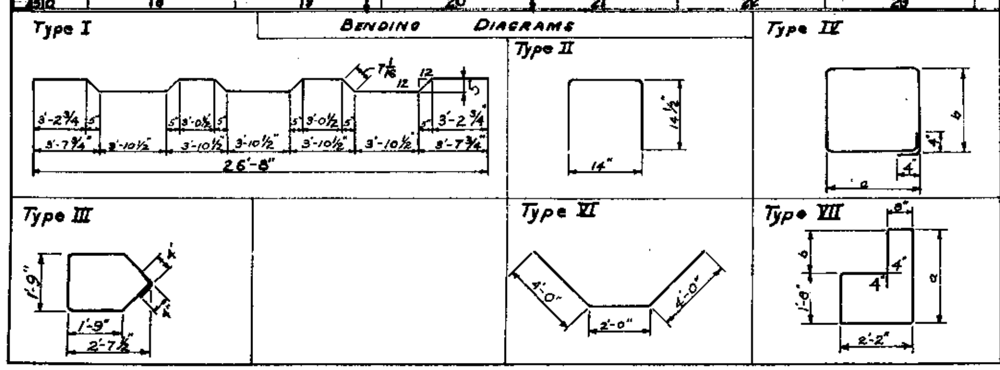
BAR SUMMARY PIER 2 (PIERS 3 & 4)

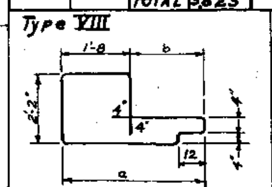
Size	Lin. ft.	lbs/ft.	lbs
#4	1971	0.668	1317
5	—	—	—
6	—	—	—
7	168	2.044	343
8	158	2.670	422
9	501	3.400	1,703
	Subtotal		3785
+1% for overrun			40
		TOTAL	3825

BAR SUMMARY SUPERSTRUCTURE

Size	Lin. ft.	lbs/ft.	lbs
4	13,900	0.668	9,285
5	12,920	1.043	13,476
6	—	—	—
7	—	—	—
8	—	—	—
9	—	—	—
	Subtotal		22,761
+1% for overrun			229
		TOTAL	22,980

BENDING DIAGRAMS





Note:
All dimensions for bent bars are out to out of bars.

GENERAL NOTES

All work shall be done according to the standard specifications of The Colorado Department of Highways applicable
All concrete shall be class "A" and air entrained as Specified.
All concrete surfaces exposed to view shall receive class "1" surface finish, except the underside of floor slabs and faces between outside stringers..
Forms for concrete surfaces exposed in the finished work shall be constructed of shiplap or tongue and groove lumber faced with panel board.
Footings in rock shall be poured out to rock and not formed.
Soundings and depth of footing shown are in accordance with the best available data and when different conditions a[illegible] the bridge engineer will inspect and determine if redesign is necessary.
All reinforcing steel shall conform to ASTM specification A 305-50T or the latest revision thereof, and shall grade steel of a deformed type. Each bar shall be tagged with the number designation and the station numb[illegible] set. Primary bars shall not be spliced and secondary bars when spliced shall lap 20 diameters of the bar. Dime[illegible] reinforcing steel not shown as clear shall be to the center line of the bar.
All structural steel shall be painted one shop coat of zinc chromate and two field coats of aluminum, unless except the unexposed portion of steel piling need not be painted.
Handrail bolts shall have hex. heads, nuts and lock washers unless otherwise specified and all rivets, ex[illegible] are ¾" dia. and shall be power driven.
When treated timber or piling is shown on the drawing the preservative for treatment shall be creosote
When excavating for footings the final one foot in depth shall be done by hand labor methods.
High tensile strength bolts may be substituted for field rivits but at no additional expense to the state. The bolts shall be assembled in accordance with specifications approved by research council on riveted and bolted structural joints of the engineering foundation Jan. 31, 1951.

DESIGNING DATA:

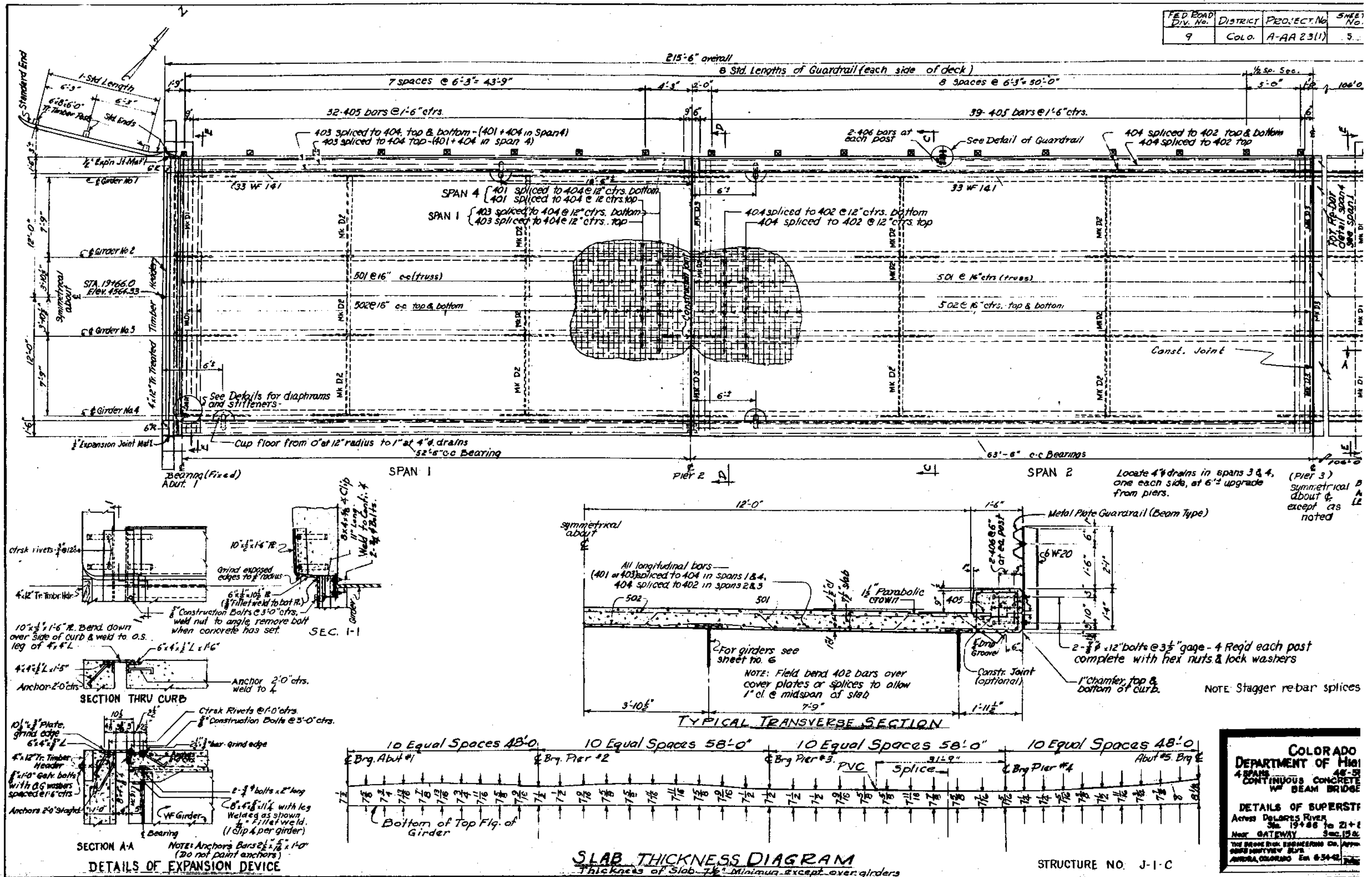
A.A.S.H.O. 1953 unit stresses, except as noted. 33 KSi
Reinforcing Steel: fs=20,000 psi; Structural Steel: fs=18,000psi; fc=1,200psi; n=10
LOADING DATA: 40 KSi 3,0 KSi
Live Load - A.A.S.H.O. (H20-S16). Dead Load:- assumes 15 lbs. per sq. ft. additional wearing surface which includes the ½ inch concrete monolithic wearing surface shown.

Prepared by: THE BRODERICK ENGINEERING CO.

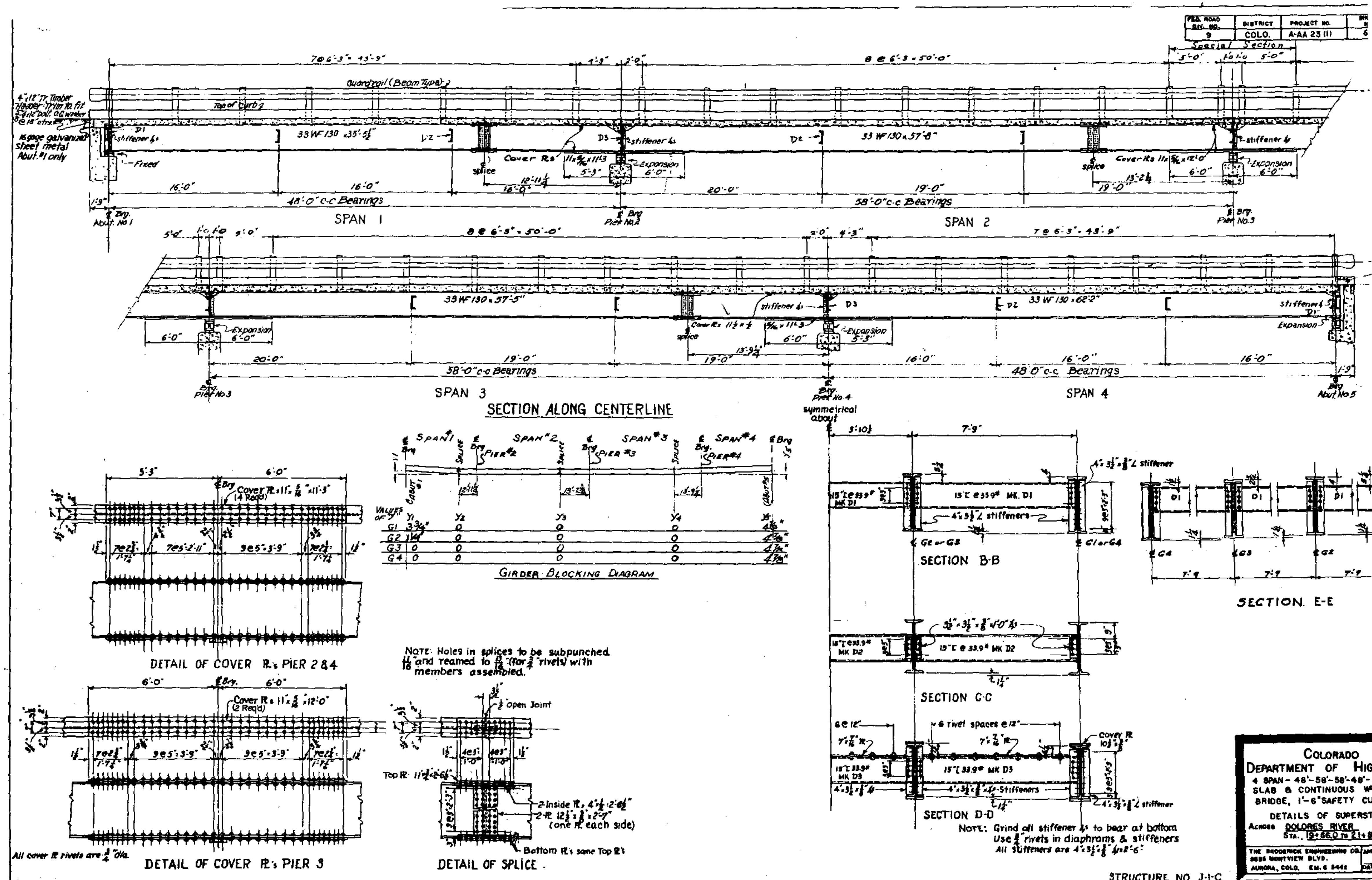
Thomas A. Broderick
Thomas A. Broderick
Registered Engineer No. 1763 STRUCTURE NO. J-1-C

COLORADO
DEPARTMENT OF HIGH[illegible]
4 SPANS 48-58-58-48 CONC[illegible]
AND CONTINUOUS WF BEAM[illegible]
1'-6" SAFETY CURB
GENERAL LAYO[illegible]
Across Dolores River
Sta. 19+66.00 to 21+81.7
Near Gateway Sec. 22 T. 5
THE BRODERICK ENGINEERING CO.
9555 MONTVIEW BLVD.
AURORA, COLORADO Em 6-5442

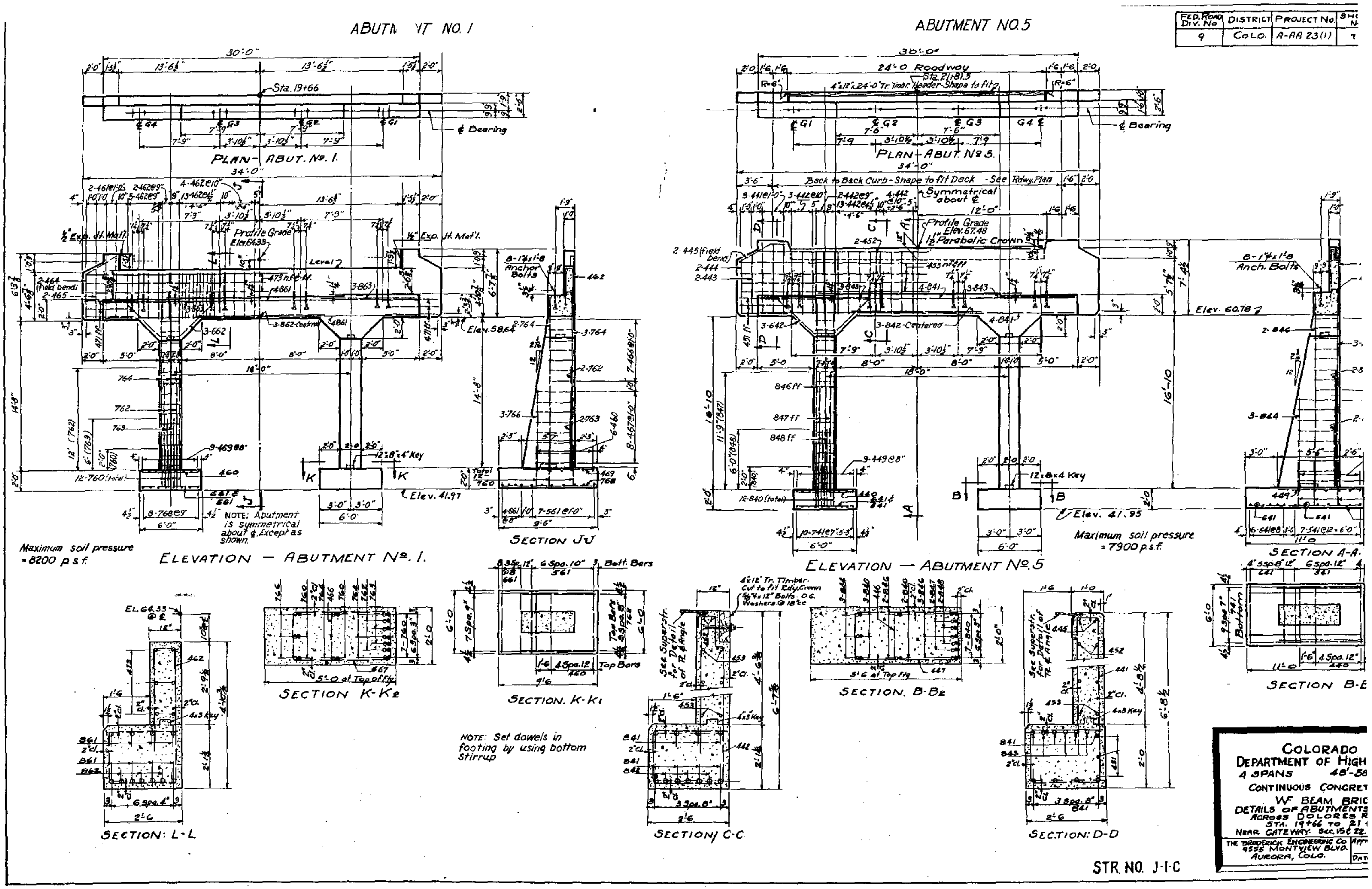
Yr. Construction = '57



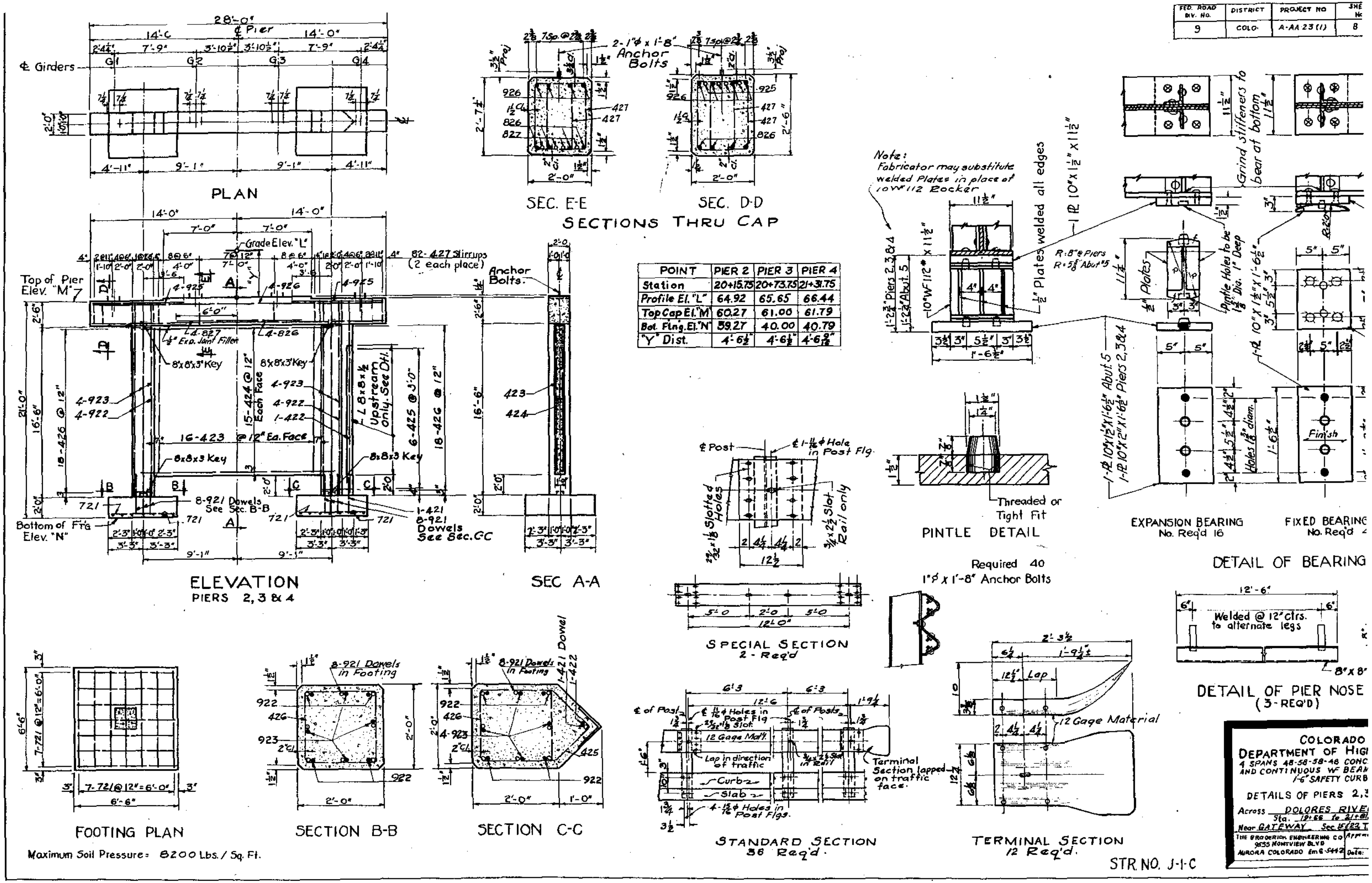
FED. ROAD DIV. No. 9
DISTRICT COLO.
PROJECT No. A-AA 23(1)
SHEET No. 5
215'-6" overall
8 Std. Lengths of Guardrail (each side of deck)
7 spaces @ 6'-3" = 43'-9"
8 spaces @ 6'-3" = 50'-0"
32-405 bars @ 1'-6" ctrs.
39-405 bars @ 1'-6" ctrs.
403 spliced to 404, top & bottom - (401 + 404 in Span 4)
405 spliced to 404 top - (401 + 404 in span 4)
2-406 bars at each post
See Detail of Guardrail
404 spliced to 402 top & bottom
404 spliced to 402 top
Standard End
1-Std Length
Std Ends
½" Expn Jt Mat'l
Girder No 1
Girder No 2
Girder No 3
Girder No 4
33 WF 141
SPAN 4 {401 spliced to 404 @ 12" ctrs. bottom / 401 spliced to 404 @ 12 ctrs. top}
SPAN 1 {403 spliced to 404 @ 12" ctrs. bottom / 403 spliced to 404 @ 12" ctrs. top}
404 spliced to 402 @ 12" ctrs. bottom
404 spliced to 402 @ 12 ctrs. top
STA. 19466.0
Elev. 4564.33
Symmetrical about ℄
4"x12" Tr. Treated Timber Header
501 @ 16" c-c (truss)
502 @ 16" c-c top & bottom
501 @ 16" ctrs (truss)
502 @ 16" ctrs. top & bottom
Construction Joint
Const. Joint
See Details for diaphrams and stiffeners
Cup floor from 0" at 12" radius to 1" at 4" ø drains
52'-6" c-c Bearing
63'-6" c-c Bearings
½" Expansion Joint Mat'l
Bearing (Fixed) Abut. 1
SPAN 1
Pier 2
SPAN 2
(Pier 3)
Locate 4" ø drains in spans 3 & 4, one each side, at 6'± upgrade from piers.
Symmetrical about ℄ except as noted
12'-0"
Metal Plate Guardrail (Beam Type)
Symmetrical about ℄
All longitudinal bars (401 or 403) spliced to 404 in spans 1 & 4, 404 spliced to 402 in spans 2 & 3
1½" Parabolic crown
2-406 bars at ea. post
6 WF 20
2-⅝" ø x 12" bolts @ 3½" gage - 4 Req'd each post complete with hex nuts & lock washers
For girders see sheet no. 6
NOTE: Field bend 402 bars over cover plates or splices to allow 1" cl. @ midspan of slab
Drip Groove
Constr. Joint (optional)
1" Chamfer, top & bottom of curb.
NOTE: Stagger rebar splices
3'-10½"
7'-9"
1'-11½"
TYPICAL TRANSVERSE SECTION
ctrsk rivets
4"x12" Tr. Timbr. Hdr.
10"x½"x1'-6" ℞
Grind exposed edges to ⅛" radius
⅝" Construction Bolts @ 3'-0" ctrs., weld nut to angle, remove bolt when concrete has set.
10"x½"x1'-6" ℞. Bend down over side of curb & weld to O.S. leg of 4"x4" L
6"x4"x½" L x 1'-6"
Anchor 2'-0" ctrs. weld to L
SEC. 1-1
SECTION THRU CURB
Ctrsk Rivets @ 1'-0" ctrs.
⅝" Construction Bolts @ 3'-0" ctrs.
Grind edge
4"x12" Tr. Timber Header
Anchors 2'-0" Stag'd
2-⅝" ø bolts x 2" long
WF Girder
Bearing
(1 clip & per girder)
SECTION A-A
NOTE: Anchors Bars (Do not paint anchors)
DETAILS OF EXPANSION DEVICE
10 Equal Spaces 48'-0
10 Equal Spaces 58'-0"
10 Equal Spaces 58'-0"
10 Equal Spaces 48'-0
℄ Brg. Abut #1
℄ Brg. Pier #2
℄ Brg Pier #3
PVC
Splice
℄ Brg Pier #4
Abut #5 Brg ℄
Bottom of Top Flg. of Girder
SLAB THICKNESS DIAGRAM
Thickness of Slab - 7½" Minimum except over girders
STRUCTURE NO. J-1-C
COLORADO
DEPARTMENT OF HIGHWAYS
4 SPANS CONTINUOUS CONCRETE WF BEAM BRIDGE
DETAILS OF SUPERSTRUCTURE
Across DOLORES RIVER
Near GATEWAY



FED. ROAD DIV. NO. 9
DISTRICT COLO.
PROJECT NO. A-AA 23 (1)
Special Section
SECTION ALONG CENTERLINE
SPAN 1
SPAN 2
SPAN 3
SPAN 4
48'-0" c-c Bearings
58'-0" c-c Bearings
Guard rail (Beam Type)
Top of Curb
33 WF 130 x 35'-5 1/2"
33 WF 130 x 57'-8"
33 WF 130 x 57'-5"
33 WF 130 x 62'-2"
Expansion
Fixed
splice
stiffener
Abut. No 1
Pier No 2
Pier No 3
Pier No 4
Abut. No 5
symmetrical about
GIRDER BLOCKING DIAGRAM
DETAIL OF COVER Pl.'s PIER 2 & 4
DETAIL OF COVER Pl.'s PIER 3
DETAIL OF SPLICE
All cover Pl. rivets are 3/4" dia.
NOTE: Holes in splices to be subpunched 11/16" and reamed to 13/16" (for 3/4" rivets) with members assembled.
SECTION B-B
SECTION C-C
SECTION D-D
SECTION E-E
NOTE: Grind all stiffener Ls to bear at bottom. Use 3/4" rivets in diaphragms & stiffeners. All stiffeners are 4 x 3 1/2 x 3/8 Ls x 2'-6"
STRUCTURE NO. J-1-C
COLORADO
DEPARTMENT OF HIGHW
4 SPAN - 48'-58'-58'-48'-CO
SLAB & CONTINUOUS WF
BRIDGE, 1'-6" SAFETY CURB
DETAILS OF SUPERSTRU
Across DOLORES RIVER
Sta. 19+66.0 to 21+91.7
THE BRODERICK ENGINEERING CO.
AURORA, COLO.



FED. ROAD DIV. No | DISTRICT | PROJECT No.
9 | COLO. | A-AA 23(1)
ABUTMENT NO. 1
PLAN - ABUT. No. 1.
ELEVATION - ABUTMENT No. 1.
Maximum soil pressure = 8200 p.s.f.
NOTE: Abutment is symmetrical about ¢ Except as shown.
SECTION J-J
ABUTMENT NO. 5
PLAN - ABUT. No 5.
ELEVATION - ABUTMENT No. 5
Maximum soil pressure = 7900 p.s.f.
SECTION A-A
SECTION: L-L
SECTION K-K2
SECTION. K-K1
NOTE: Set dowels in footing by using bottom Stirrup
SECTION C-C
SECTION. B-B2
SECTION: D-D
SECTION B-B
COLORADO
DEPARTMENT OF HIGH
4 SPANS
CONTINUOUS CONCRET
WF BEAM BRIC
DETAILS OF ABUTMENTS
ACROSS DOLORES R
NEAR GATEWAY
THE BRODERICK ENGINEERING CO
9556 MONTVIEW BLVD.
AURORA, COLO.
STR. NO. J-1-C



POINT	PIER 2	PIER 3	PIER 4
Station	20+15.75	20+73.75	21+31.75
Profile El. "L"	64.92	65.65	66.44
Top Cap El. "M"	60.27	61.00	61.79
Bot. Ftng. El. "N"	59.27	40.00	40.79
"Y" Dist.	4'-6½"	4'-6½"	4'-6 9/16"

FED. ROAD DIV. NO.	DISTRICT	PROJECT NO.	SHE[ET] NO.
9	COLO.	A-AA 23 (1)	8

COLORADO
DEPARTMENT OF HIG[HWAYS]
4 SPANS 48-58-58-48 CONC[RETE]
AND CONTINUOUS WF BEAM
1'-6" SAFETY CURB

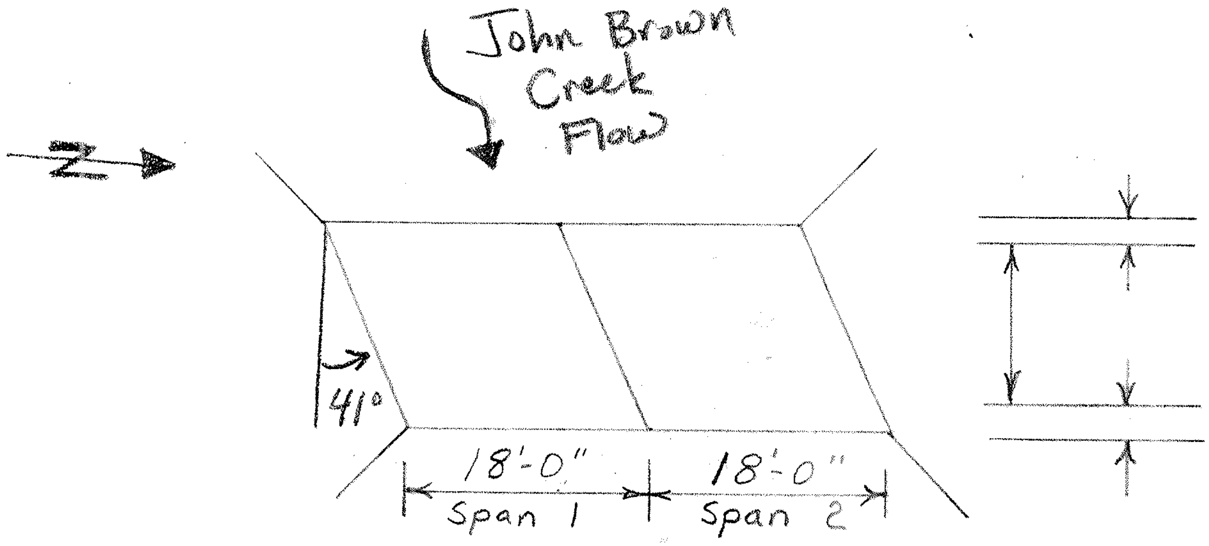
DETAILS OF PIERS 2,3

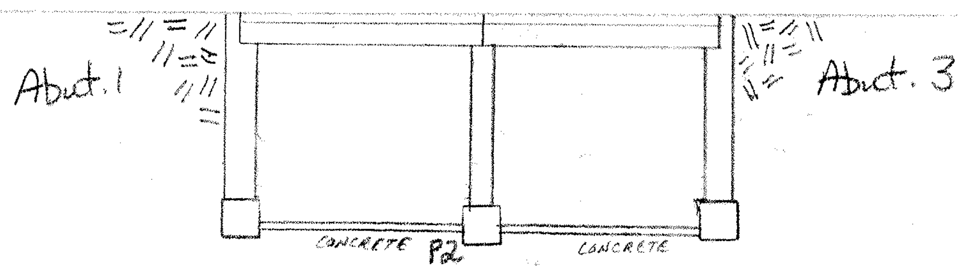
Across DOLORES RIVE[R]
Sta. 19+66 to 21+8[...]
Near GATEWAY Sec. 15 & 22 T[...]

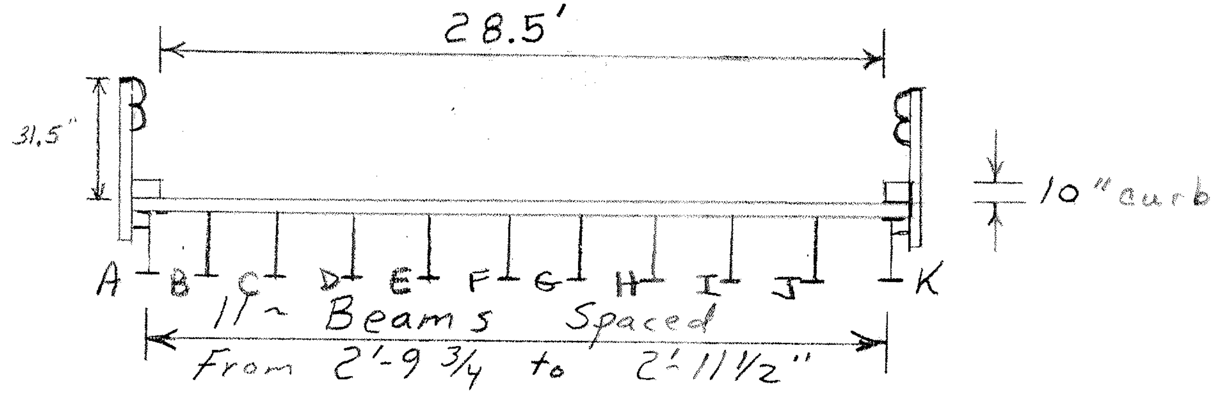
THE BRODERICK ENGINEERING CO
9555 MONTVIEW BLVD
AURORA COLORADO Em 6-5442

Appr[oved]
Date:

J-01-D


John Brown Creek Flow
N
41°
18'-0"
Span 1
18'-0"
Span 2


Abut. 1
Abut. 3
CONCRETE
P2
CONCRETE


28.5'
31.5"
10" curb
A B C D E F G H I J K
11 ~ Beams Spaced
From 2'-9 3/4 to 2'-11 1/2"

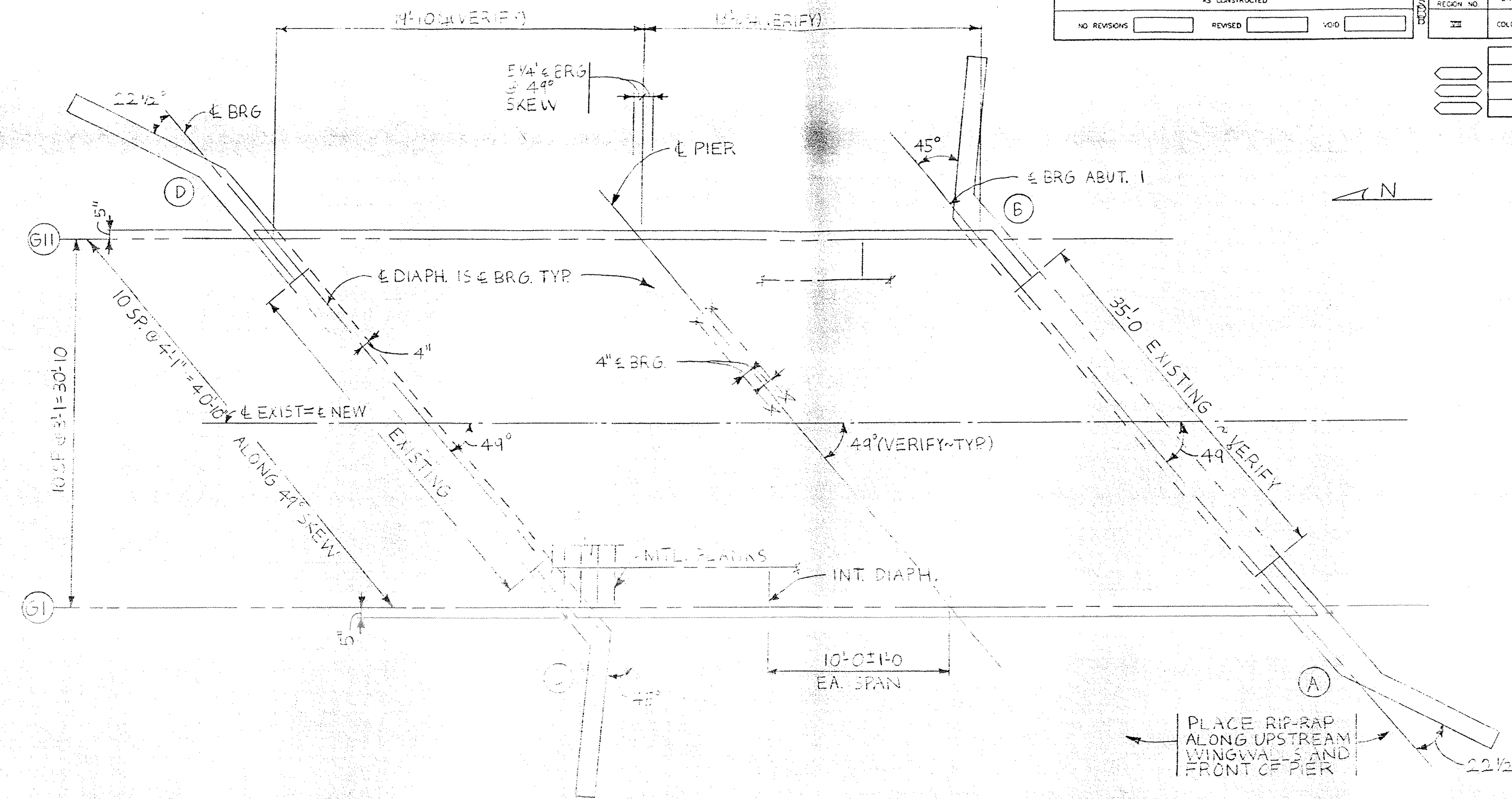
J-01-D

Timber Stringer wood deck = SSM

AS CONSTRUCTED		
NO REVISIONS	REVISED	VOID

FEDERAL ROAD REGION NO.	DIVISION	PROJECT NUMBER	SHEET NUMBER
VIII	COLORADO	MP	1

REVISIONS



Designed By	Checked By	Detailed By	INITIAL	DATE	Checked By	Quantities By	Checked By

NOTES:

1. SOIL BEARING PRESSURE USED IN DESIGN= 3000 PSF. EFP= 40 PCF.
2. ANCHOR BOLTS SHALL BE ASTM A307 BOLTS OR ASTM A36 ALLTHREAD BARS.
3. SALVAGED STEEL BEAMS AND METAL DECK PLANKING SHALL BE IN GOOD CONDITION AND FREE OF ANY DEFECTS. STEEL BEAMS SHALL HAVE NO PREVIOUS WELDS ON THE BOTTOM FLANGES.
4. EPOXY FOR GROUTING IN DOWELS AND ANCHOR BOLTS SHALL BE HILTI HBP OR EQUIV. IN 1/4 INCH OVERSIZE HOLES.
5. DIMENSIONS AND SKEW ANGLES SHALL BE VERIFIED PRIOR TO FABRICATION.
6. CONCRETE SHALL BE CLASS B. f'c=3000 PSI.
7. REMOVAL OF EXIST. CONC. SHALL BE WITH AN 1 1/2 INCH SAWCUT AND 10LB JACKHAMMER MAX. ALONG THE EDGE OF CONCRETE TO REMAIN.
8. ALL CONSTRUCTION SHALL ADHERE TO CDOH STANDARDS, SPECIFICATIONS, AND POLICIES.
9. LIVE LOAD - SERVICE LOAD DESIGN, AASHTO HS 20-44 AND INTERSTATE ALTERNATE.
10. REINFORCING STEEL - f_s=24,000 PSI, f_y=60,000 PSI.
11. STRUCTURAL STEEL - AASHTO M-183(ASTM A36), f_s=20,000 PSI.
12. FIELD VERIFY ALL DIMENSIONS
13. LOCATE ALL POTENTIAL UNDERGROUND UTILITIES PRIOR TO CONSTRUCTION.
14. STRUCTURE EXCAVATION AND BACKFILL SHALL BE IN ACCORDANCE WITH STANDARD M-206-2.

BAR SIZE	#4	#5	#6	#7	#8	#9	#10	#11
SPLICE LENGTH FOR CLASS B CONCRETE	1'-3"	1'-6"	2'-0"	2'-8"	3'-6"	4'-5"	5'-7"	6'-10"

15. ALL REBAR HOOKS SHALL BE 1'-0 MIN.

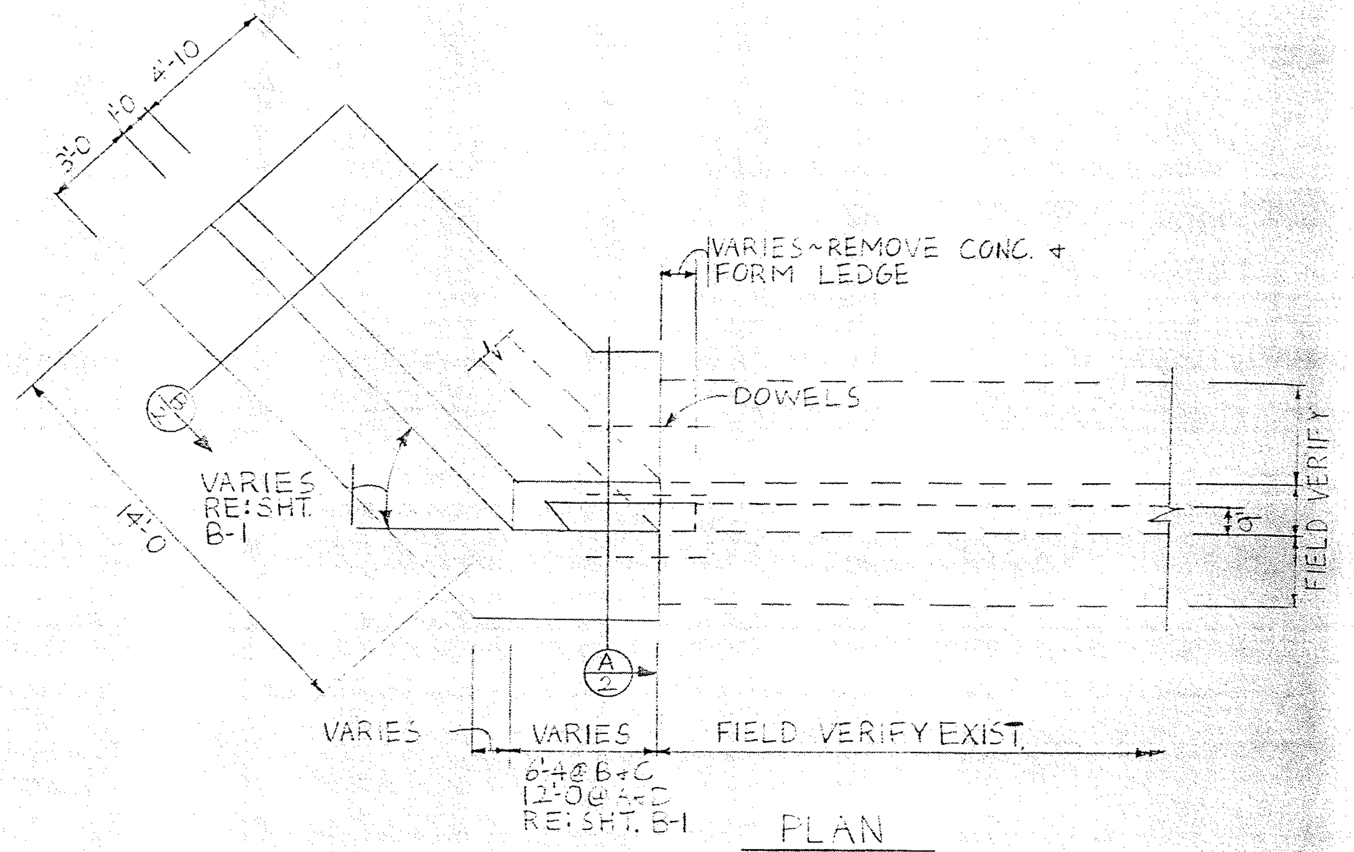
DIVISION OF HIGHWAYS

CONSTRUCTION LAYOUT

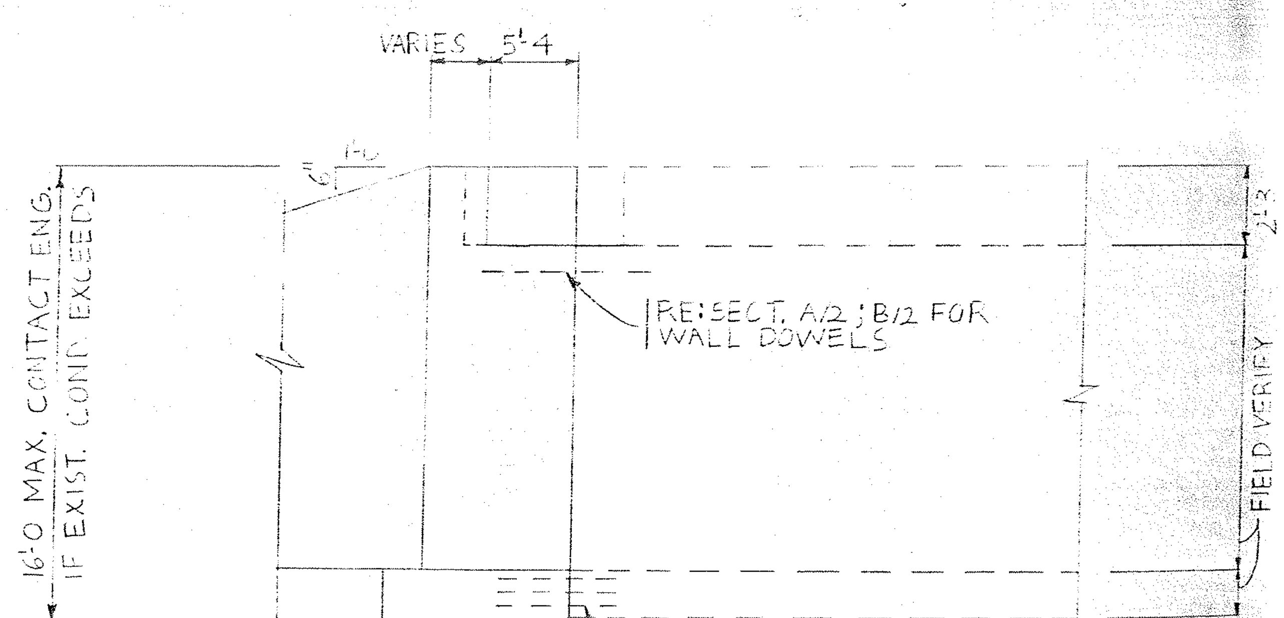
Designer M. DODSON	Structure Numbers	J-1-D
Detailer M. DODSON		
Drawing Number B1	of	Drawings

Revision Dates

AS CONSTRUCTED			FEDERAL ROAD REGION NO.	DIVISION	PROJECT NUMBER	SHEET NUMBER
NO REVISIONS	REVISED	VOID	II	COLORADO	MP	2

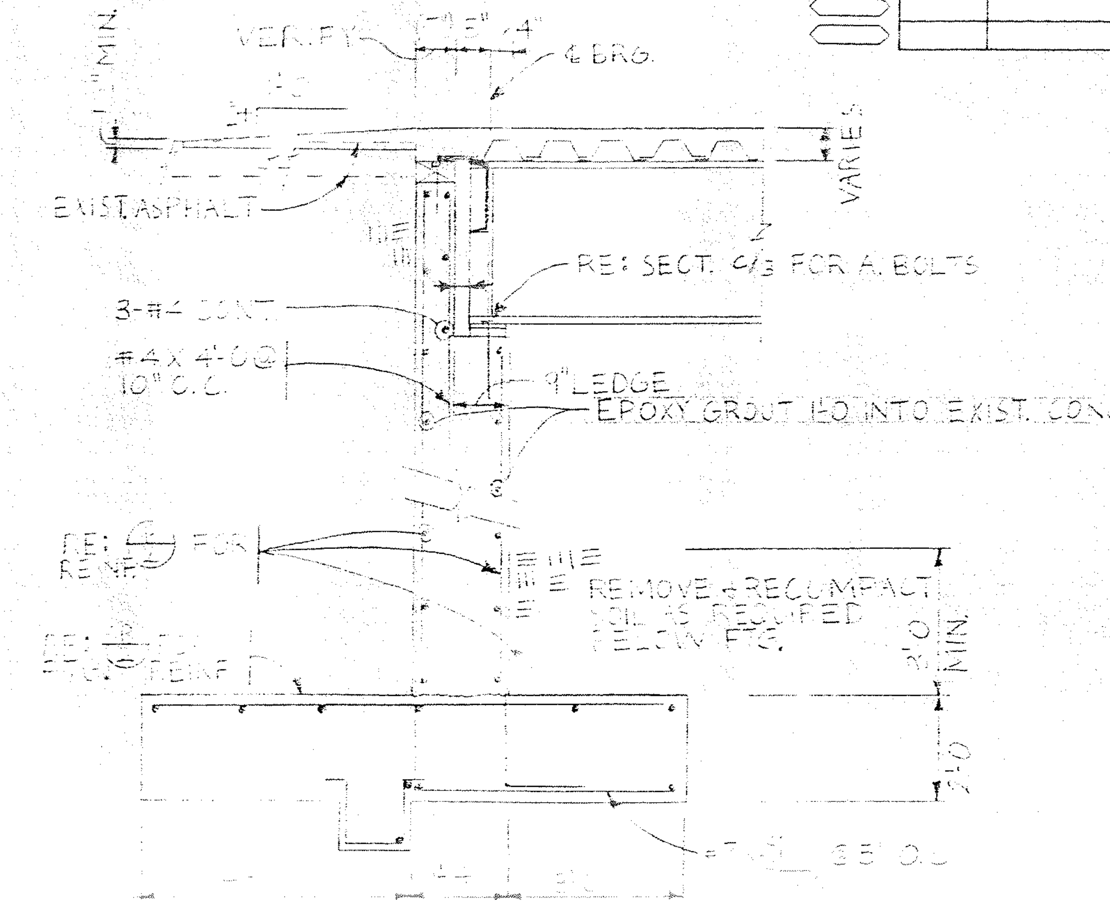


PLAN

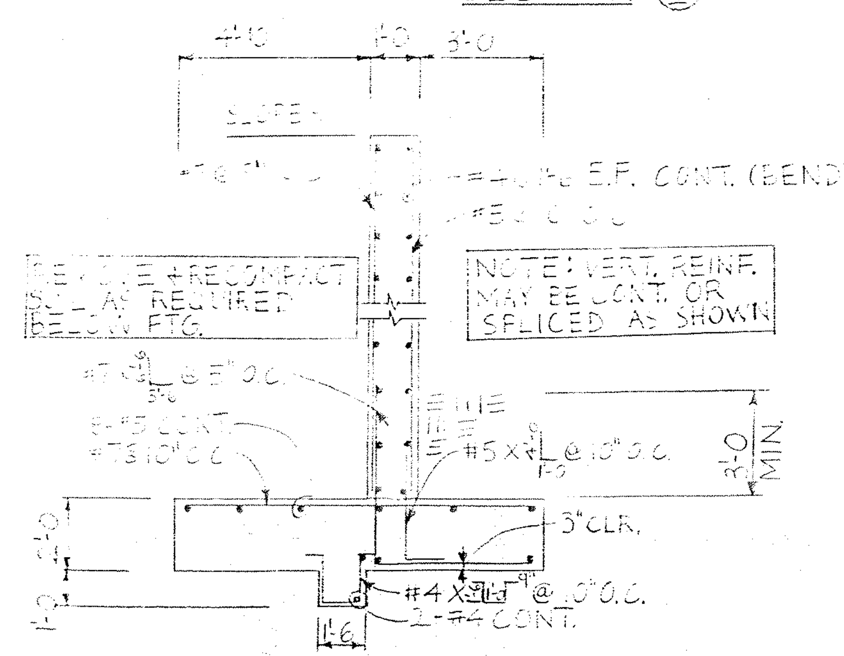


ELEVATION

NOTES:
1. RE: SHT. B-1 FOR GIRDER LAYOUT



SECTION A

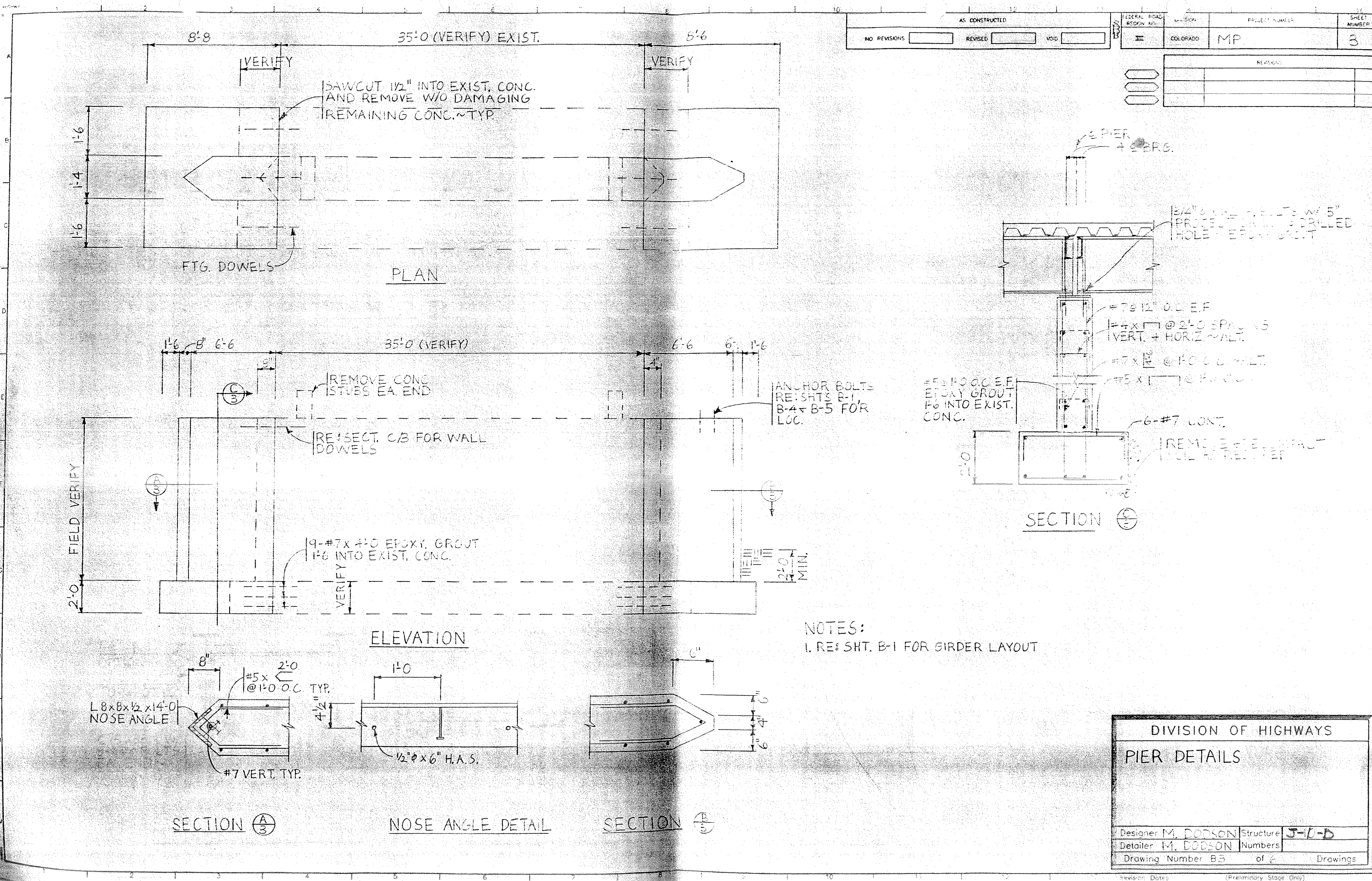


SECTION B

DIVISION OF HIGHWAYS

ABUTMENT DETAILS

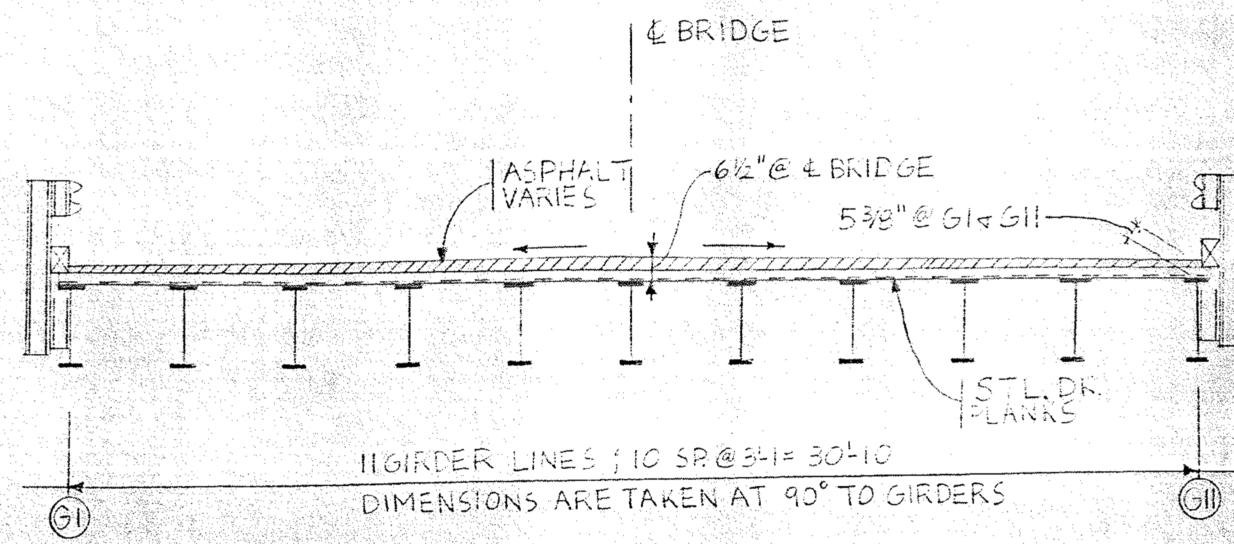
Designer	M. DODSON	Structure	J-1-D
Detailer	N. DODSON	Numbers	
Drawing Number B2		of 6	Drawings


AS CONSTRUCTED
NO REVISIONS
REVISED
VOID
FEDERAL ROAD REGION NO.
III
DIVISION
COLORADO
PROJECT NUMBER
MP
SHEET NUMBER
3
REVISIONS
8'-8
35'-0 (VERIFY) EXIST.
8'-6
VERIFY
VERIFY
SAWCUT 1½" INTO EXIST. CONC. AND REMOVE W/O DAMAGING REMAINING CONC.~TYP.
1'-6
1'-4
1'-6
FTG. DOWELS
PLAN
1'-6
8"
6'-6
35'-0 (VERIFY)
6'-6
6"
1'-6
9"
4"
REMOVE CONC. STUBS EA. END
ANCHOR BOLTS RE: SHTS B-1, B-4 & B-5 FOR LOC.
RE: SECT. C/3 FOR WALL DOWELS
FIELD VERIFY
9-#7 x 4'-0 EPOXY GROUT 1'-6 INTO EXIST. CONC.
VERIFY
2'-0
2'-0 MIN.
ELEVATION
℄ PIER & ℄ BRG.
#7 @ 12" O.C. E.F.
#4 x ⊓ @ 2'-0 SPACING VERT. & HORIZ.~ALT.
#5 @ 1'-0 O.C. E.F. EPOXY GROUT 1'-6 INTO EXIST. CONC.
6-#7 CONT.
2'-0
SECTION C/3
NOTES:
1. RE: SHT. B-1 FOR GIRDER LAYOUT
8"
#5 x 2'-0 @ 1'-0 O.C. TYP.
L 8x8x½ x 14'-0 NOSE ANGLE
#7 VERT. TYP.
SECTION A/3
1'-0
4½"
½"φ x 6" H.A.S.
NOSE ANGLE DETAIL
6"
6"
4"
6"
SECTION B/3
DIVISION OF HIGHWAYS
PIER DETAILS
Designer M. DODSON
Detailer M. DODSON
Structure Numbers J-10-D
Drawing Number B3 of 6 Drawings
Revision Dates (Preliminary Stage Only)
Designed By
Checked By
Detailed By
Quantities By
Checked By

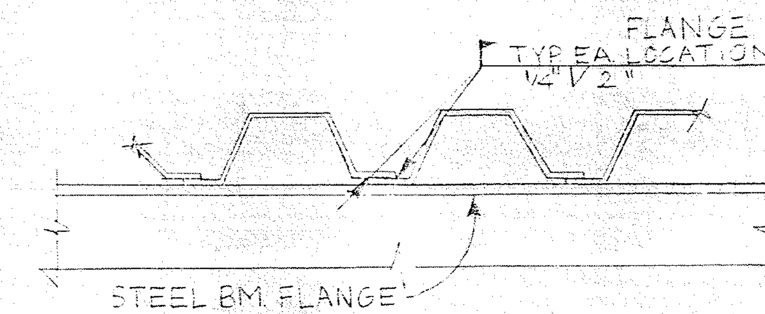
AS CONSTRUCTED		
NO REVISIONS	REVISED	VOID

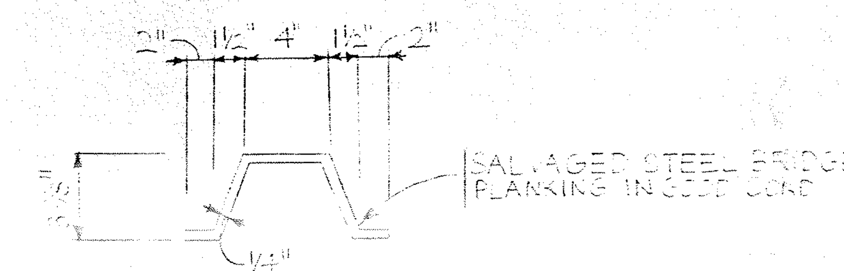
FEDERAL ROAD REGION NO.	DIVISION	PROJECT NUMBER	SHEET NUMBER
X	COLORADO	MP	4

REVISIONS

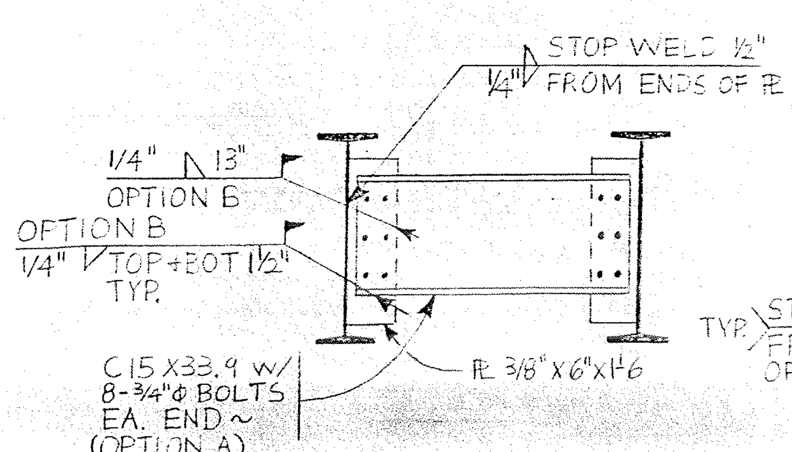


TYPICAL SECTION

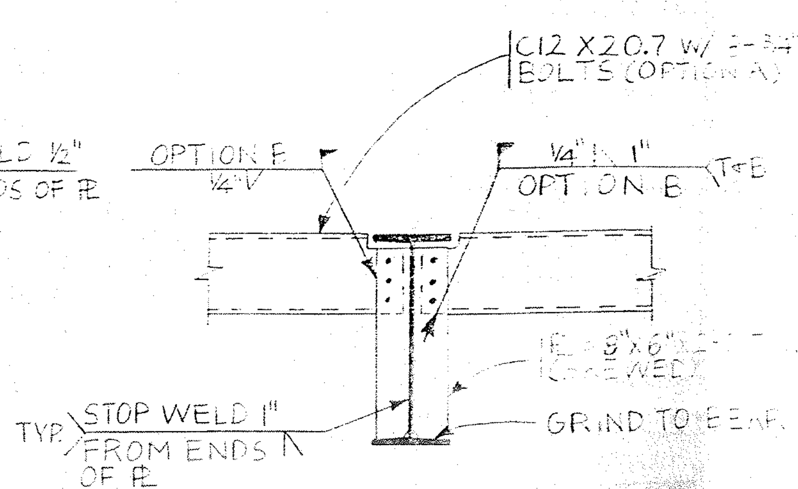




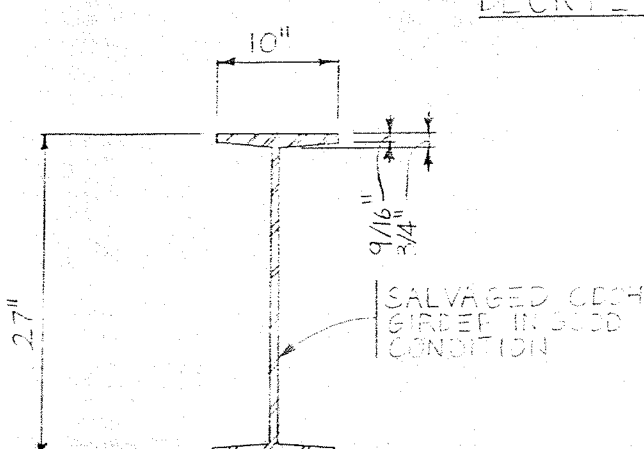
DECK PLANK



INTERMEDIATE DIAPHRAM



ABUTMENT & PIER DIAPHRAMS



TYP. GIRDER

Designed By	Checked By	Detailed By
Checked By	Quantities By	Checked By

DIVISION OF HIGHWAYS

SUPERSTRUCTURE DETAILS

Designer M. DODSON
Detailer M. DODSON
Drawing Number B4
Structure Numbers F-11-D
of Drawings

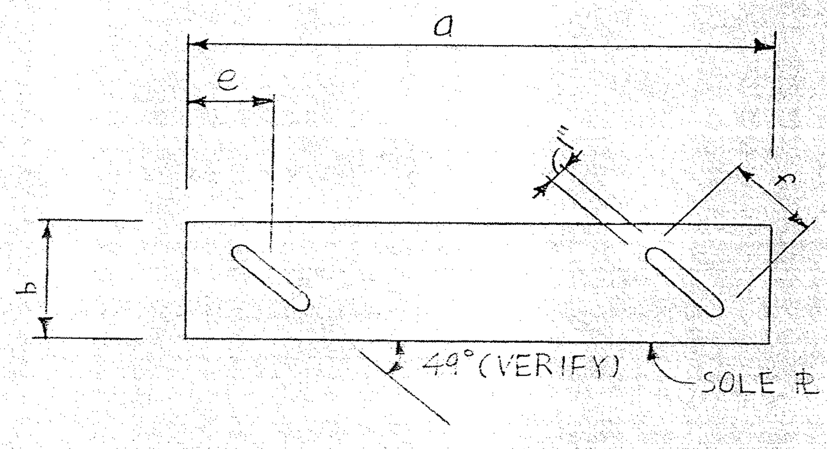
Revision Date (Preliminary Stage Only)

AS CONSTRUCTED		
NO REVISIONS	REVISED	VOID

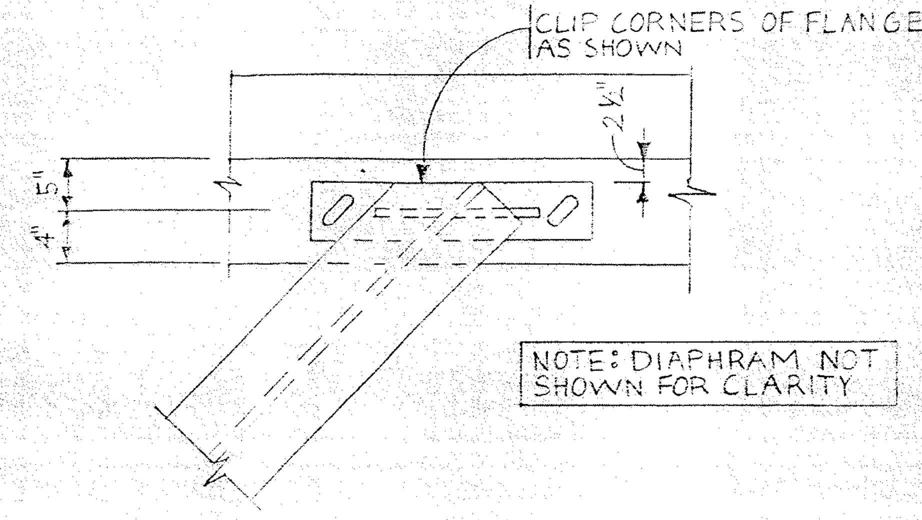
FEDERAL ROAD REGION NO.	DIVISION	PROJECT NUMBER	SHEET NUMBER
VIII	COLORADO	MP	5

REVISIONS

B-512-1



PLAN



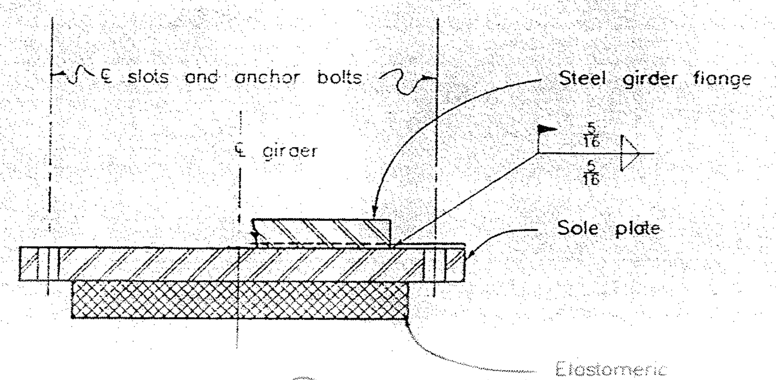
PLAN AT ABUT.

NOTES:

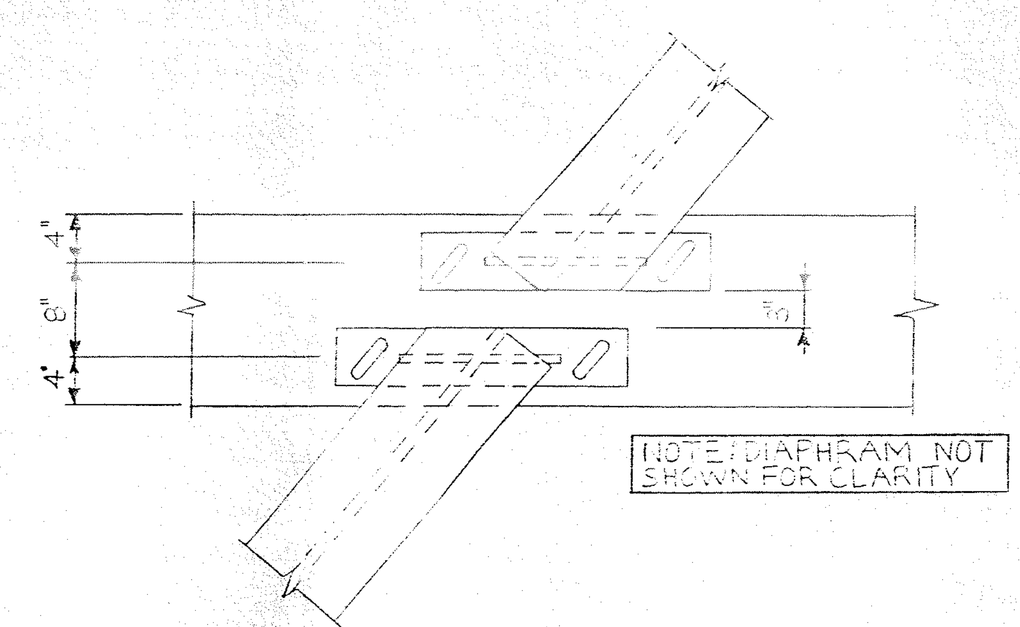
Anchor bolt nuts shall be snugged and jammed with jam nuts at fixed bearings. At expansion bearings, provide ½" clearance between jam nut and sole plate under all temperature conditions prior to jamming.

Do not paint steel surfaces in contact with elastomeric pad.

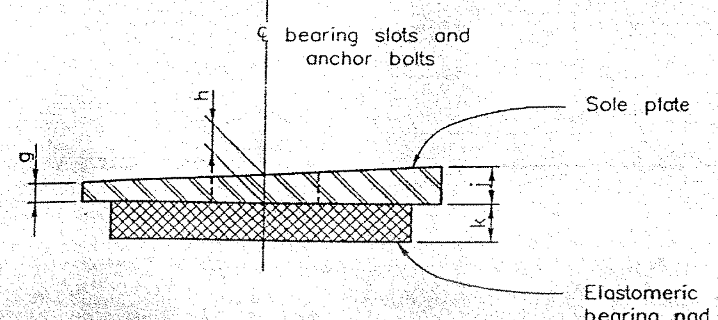
Elastomeric pad, Sole plate, anchor bolts and miscellaneous hardware shall be included in the bid price for Item 512, Bearing Device (Type I).



SECTION B/A



PLAN AT PIER



SECTION B/B

ELASTOMERIC BEARING DETAILS

		Dimensions (Inches)									
Location	No. Req'd	a	b	c	d	e	f	g	h	j	k
ABUT.'S	22	24	5			3½	4	½	½	½	3/4
PIER	22	24	5			3½	1	½	½	½	3/4

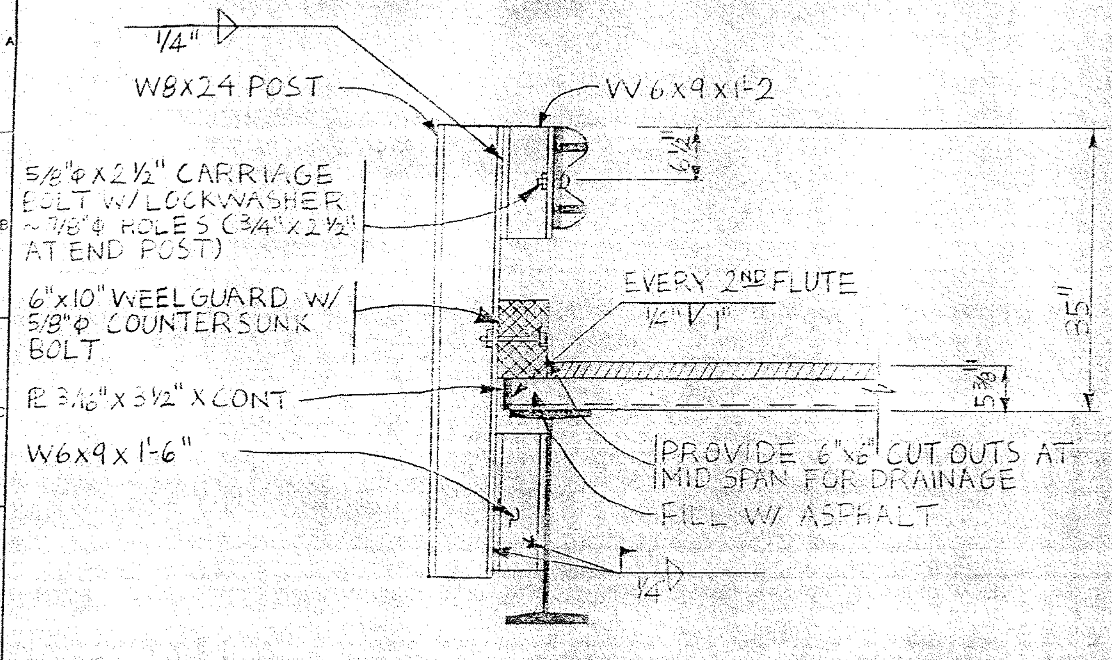
DIVISION OF HIGHWAYS

BEARING DEVICE (TYPE I)

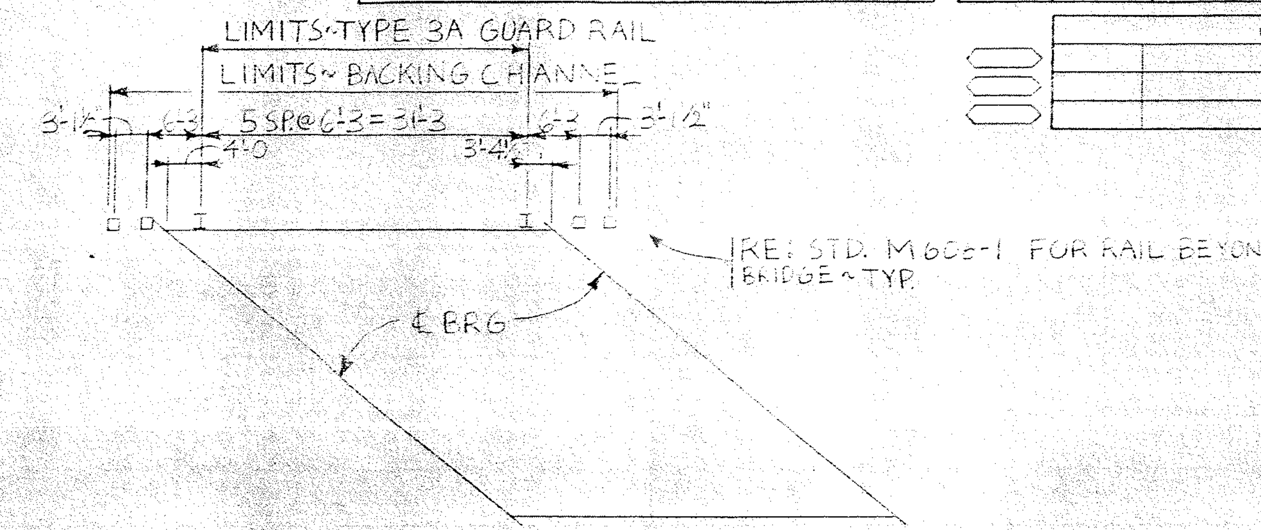
Designer	M. DODSON	Structure Numbers	J-1-D ~~J-10-D~~
Detailer	M. DODSON		
Drawing Number B5	of 6	Drawings	

Revision Dates (Preliminary Stage Only)
12-87 10-88

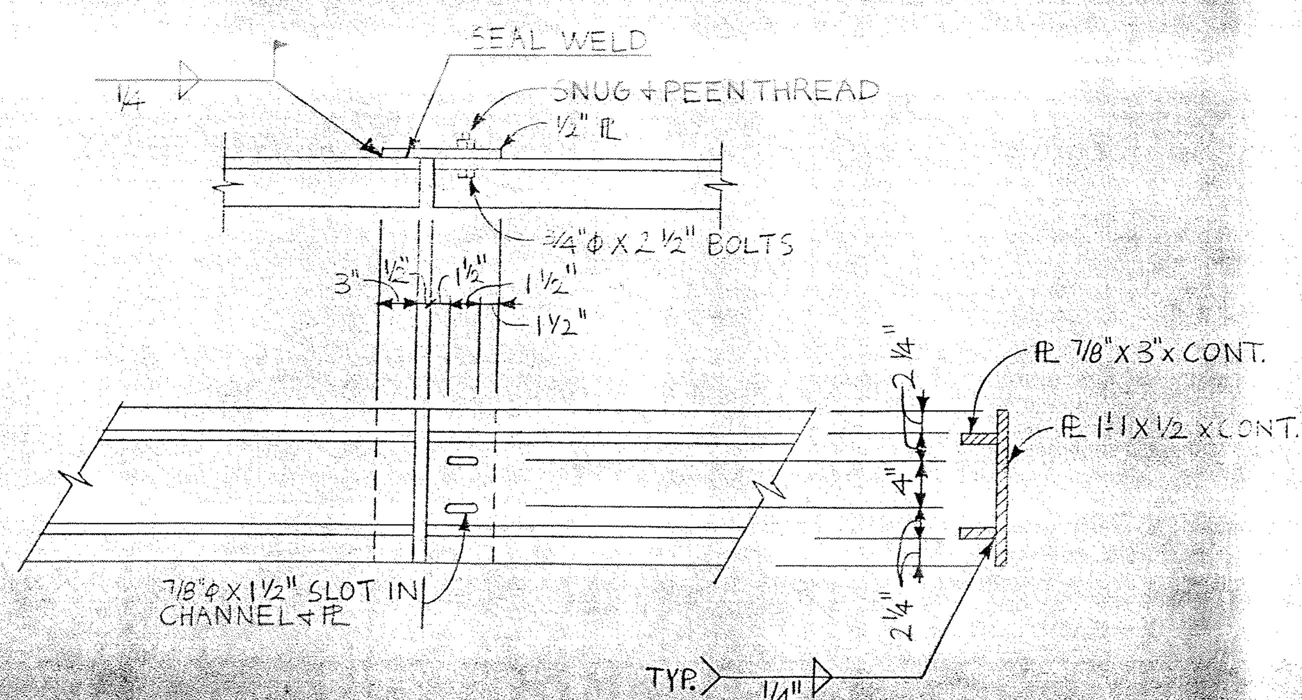
Checked By | Detailed By | Quantities By | Checked By



POST MOUNTING DETAILS



BRIDGE RAIL SPACING
TYP. BOTH SIDES



CHANNEL SPLICE DETAILS

NOTES:

1. ALL POSTS, POST BLOCKS, CHANNELS, CHANNEL SPLICES, ANGLE ASSEMBLIES, BOLTS, NUTS, AND WASHERS SHALL BE GALVANIZED AFTER FABRICATION IN ACCORDANCE WITH THE SPECIFICATIONS.
2. CHANNELS SHALL BE CONTINUOUS OVER NOT LESS THAN TWO POST.
3. POSTS SHALL BE PERPENDICULAR TO THE GRADE OF THE DECK.
4. CONTRACTOR SHALL PROVIDE TERMINAL SECTION (FLARED) WHEN NO APPROACH GUARD RAIL IS USED WITH THE COST INCLUDED IN ITEM NO. 606-BRIDGE RAIL, TYPE 3 MODIFIED. FOR DETAILS SEE STD M-606-1.
5. FOR ADDITIONAL DETAILS SEE STD M-606-1.
6. ALL WORK SHALL BE DONE ACCORDING TO THE STANDARD SPECIFICATIONS OF THE DIVISION OF HIGHWAYS, STATE OF COLORADO, APPLICABLE TO THE PROJECT.
7. ALL STRUCTURAL STEEL SHALL BE AASHTO SPECIFICATION M-183. (ASTM A-36).

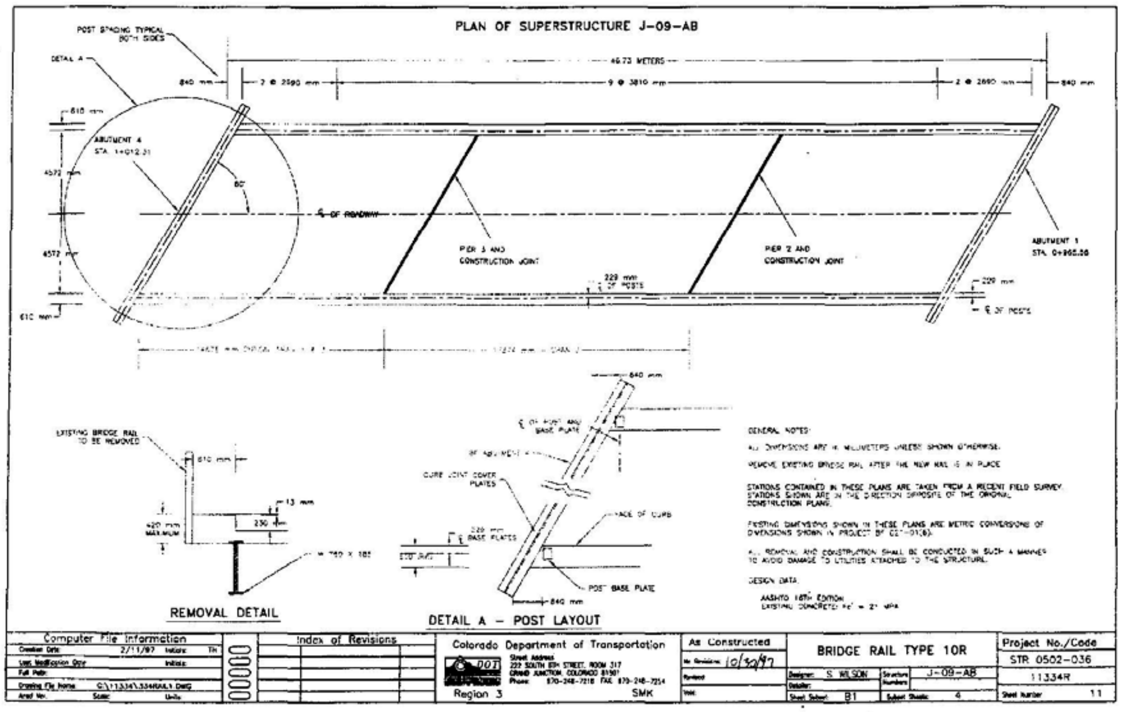
DIVISION OF HIGHWAYS

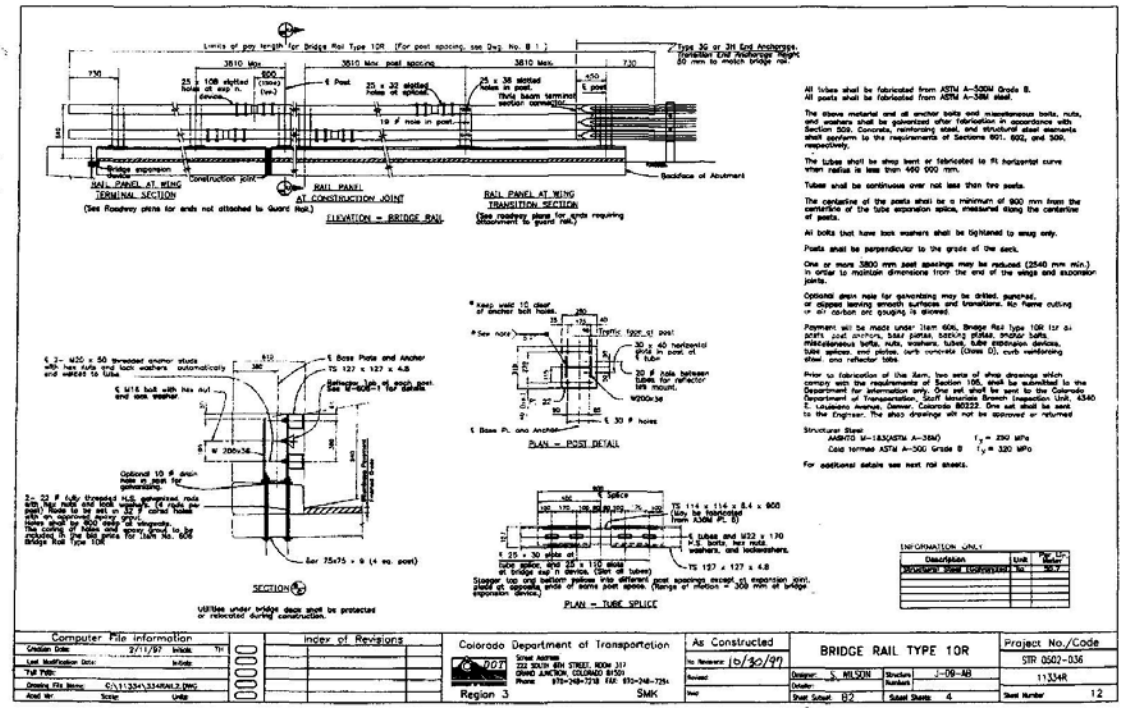
BRIDGE RAIL TYPE 3 (MODIFIED)

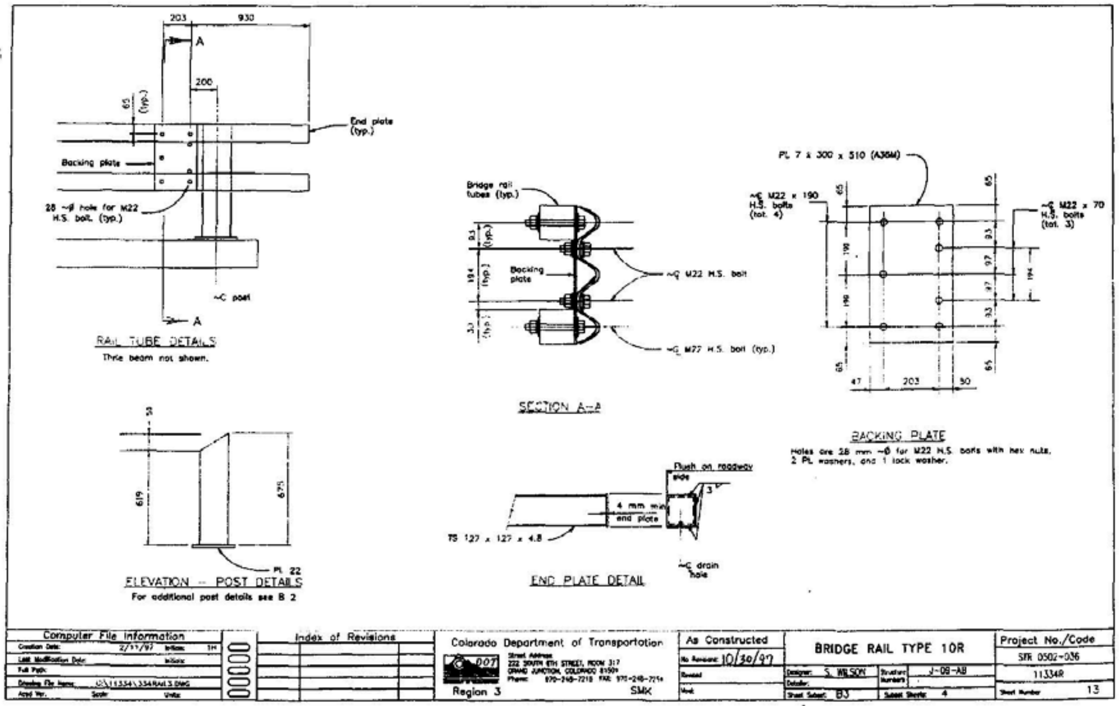
Designer M. DODSON	Structure Numbers ~~J-10-D~~ J-1-D
Detailer M. DODSON	
Drawing Number B6 of 6 Drawings	

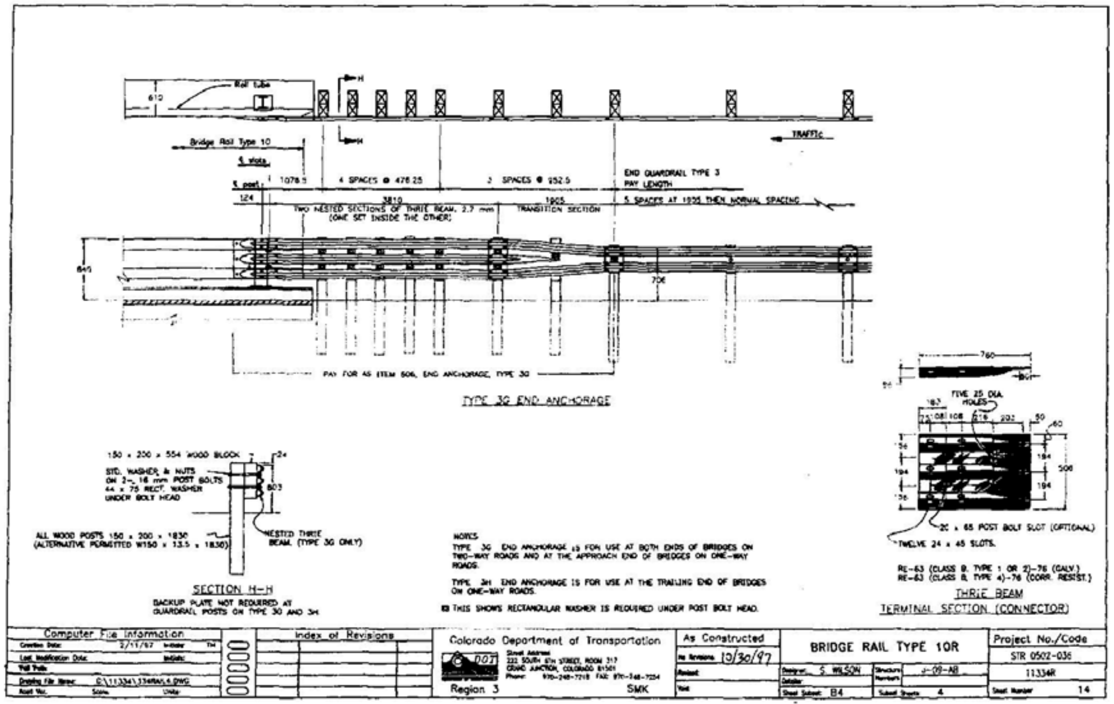
Revision Date: (Preliminary Stage Only)

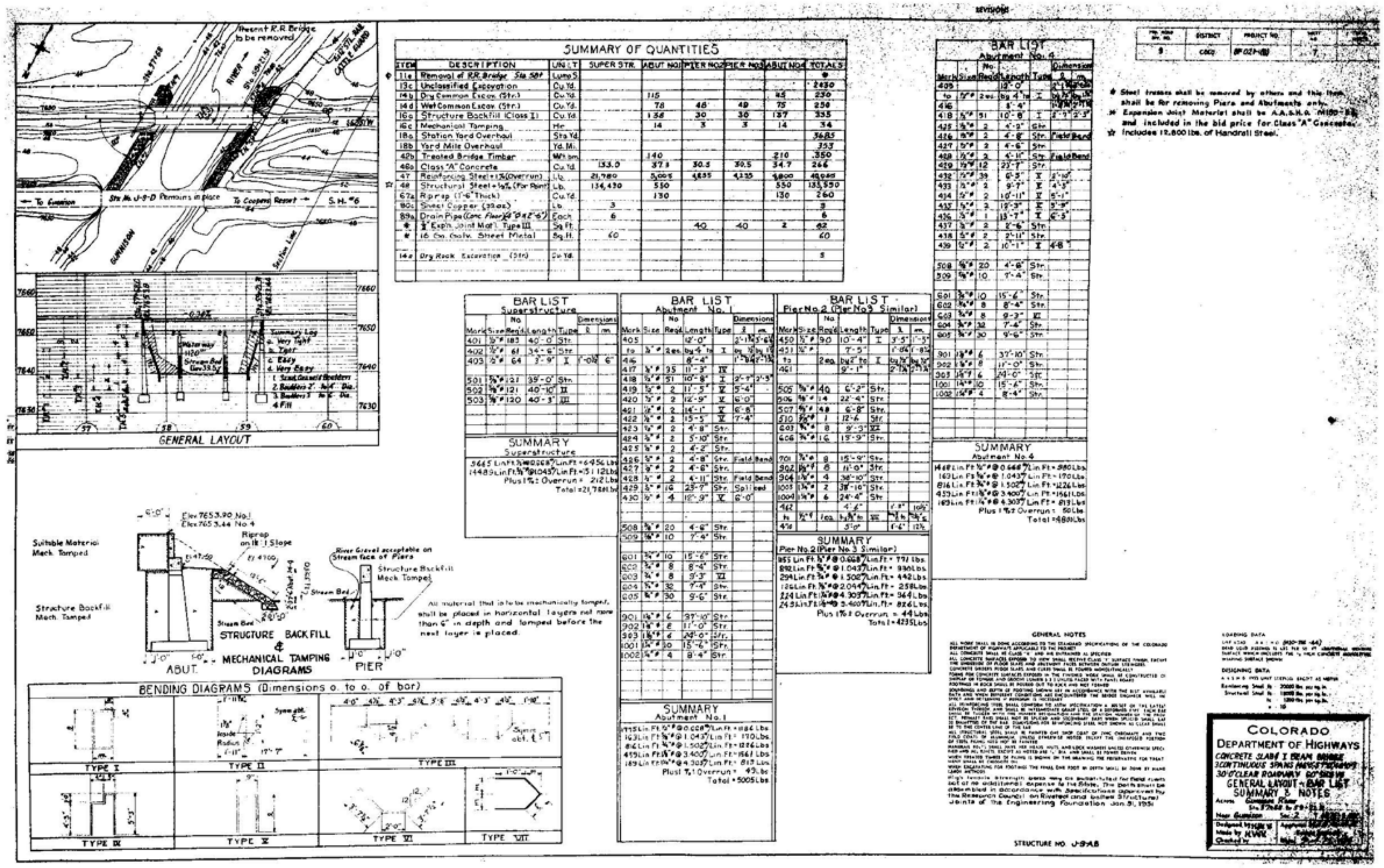
Designed By / Checked By / Detailed By / Checked By / Quantities By / Checked By | INITIAL | DATE

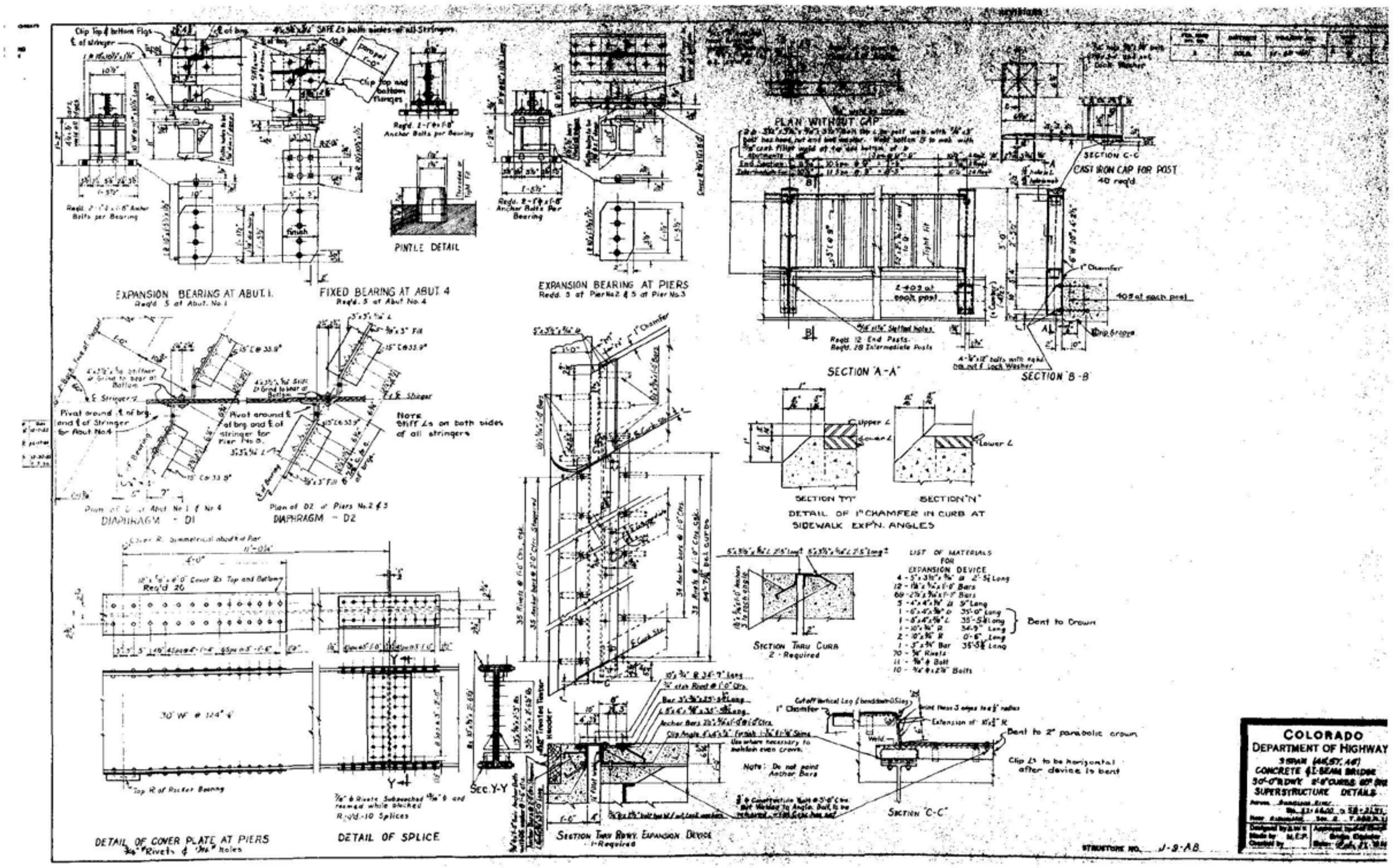

PLAN OF SUPERSTRUCTURE J-09-AB
REMOVAL DETAIL
DETAIL A – POST LAYOUT
Computer File Information
Index of Revisions
Colorado Department of Transportation
Region 3
SMK
As Constructed
BRIDGE RAIL TYPE 10R
S. WILSON
J-09-AB
Project No./Code
STR 0502-036
11334R
11

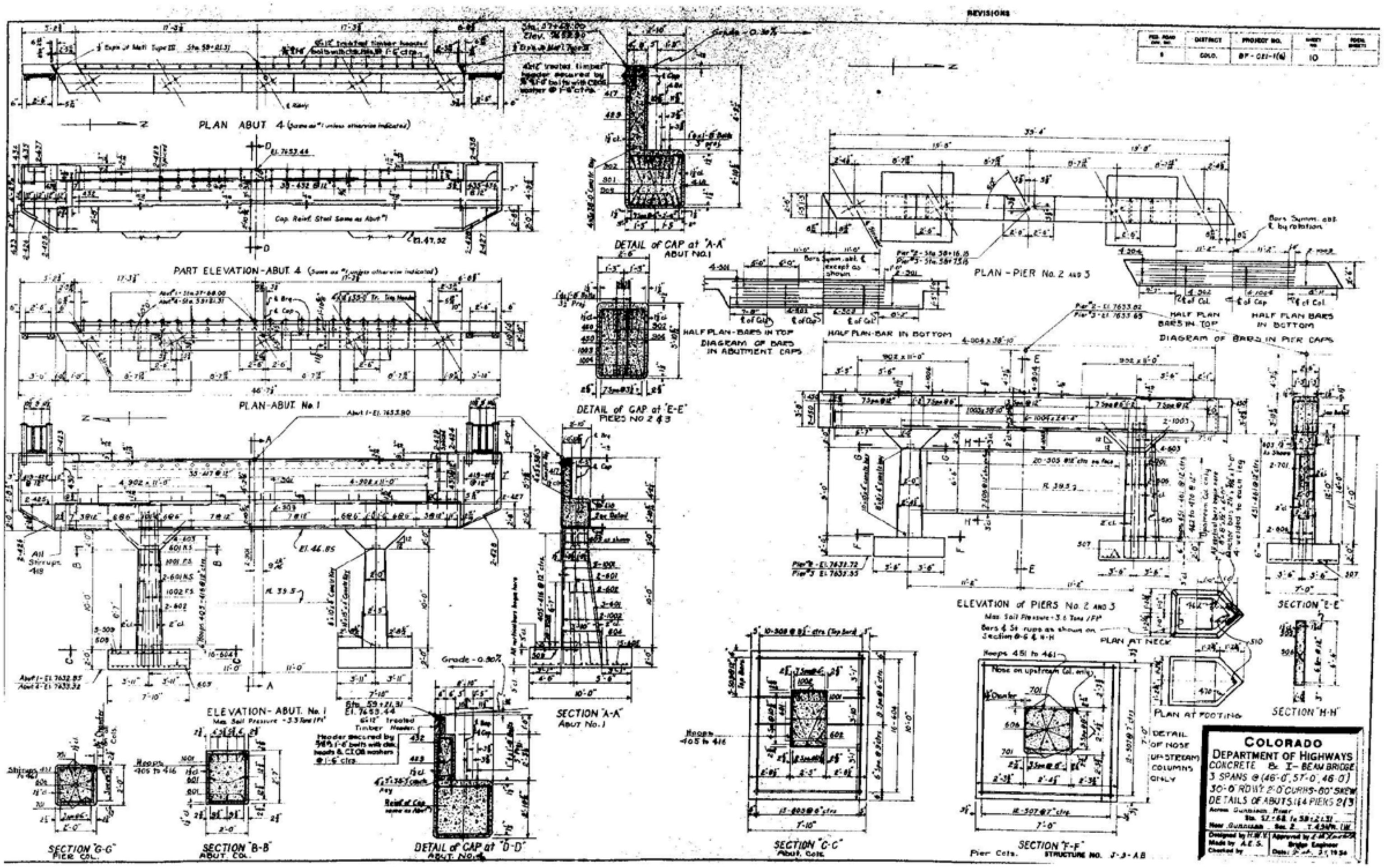

ELEVATION – BRIDGE RAIL
PLAN – POST DETAIL
PLAN – TUBE SPLICE
SECTION
Computer File Information
Index of Revisions
Colorado Department of Transportation
Region 3
As Constructed
BRIDGE RAIL TYPE 10R
Project No./Code
STR 0502-036
11334R
J-09-AB

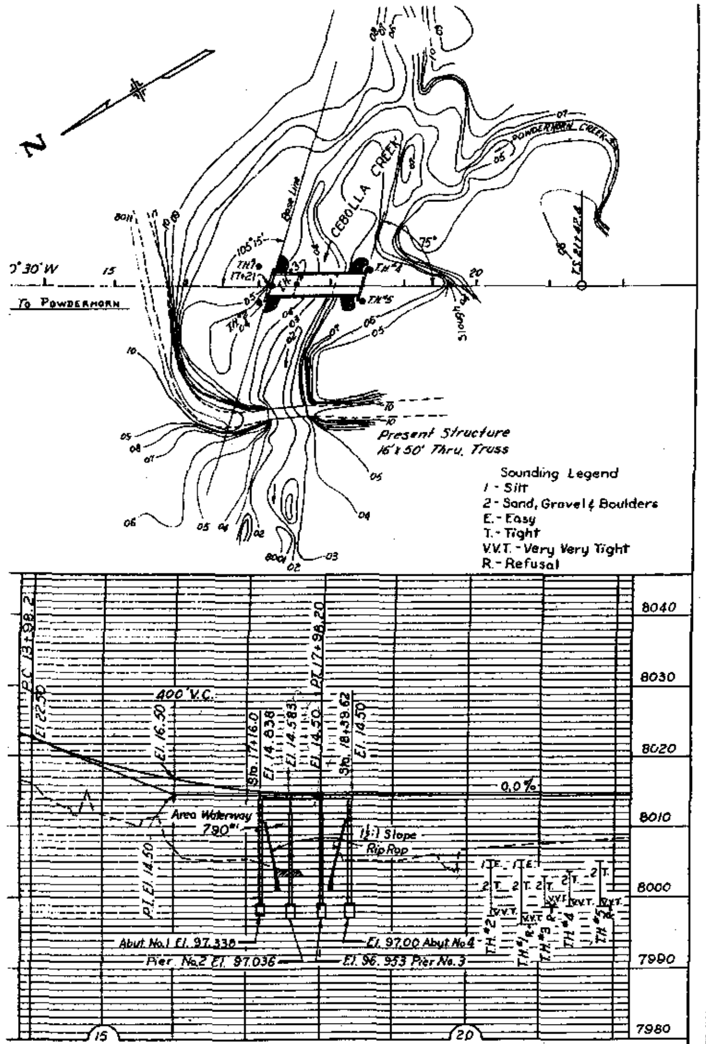

RAIL TUBE DETAILS
Thrie beam not shown.
End plate (typ.)
Backing plate
28 ~ø hole for M22 H.S. bolt. (typ.)
~C post
SECTION A–A
Bridge rail tubes (typ.)
~C M22 H.S. bolt
~C M22 H.S. bolt (typ.)
PL 7 x 300 x 510 (A36M)
~C M22 x 190 H.S. bolts (tot. 4)
~C M22 x 70 H.S. bolts (tot. 3)
BACKING PLATE
Holes are 28 mm ~ø for M22 H.S. bolts with hex nuts, 2 PL washers, and 1 lock washer.
ELEVATION – POST DETAILS
For additional post details see B 2
PL 22
END PLATE DETAIL
Flush on roadway side
4 mm min end plate
TS 127 x 127 x 4.8
~C drain hole
Computer File Information
Creation Date: 2/11/97
Index of Revisions
Colorado Department of Transportation
222 South 6th Street, Room 317
Grand Junction, Colorado 81501
Phone: 970-248-7210 FAX: 970-248-7254
Region 3
SMX
As Constructed
No Revisions: 10/30/97
BRIDGE RAIL TYPE 10R
Designer: S. WILSON
Structure Numbers J-09-AB
Sheet Subset: B3
Subset Sheets: 4
Project No./Code
STR 0502-036
11334R
Sheet Number 13


TYPE 3G END ANCHORAGE
SECTION H-H
THRIE BEAM
TERMINAL SECTION (CONNECTOR)
Colorado Department of Transportation
BRIDGE RAIL TYPE 10R
Region 3
STR 0502-036
11334R


SUMMARY OF QUANTITIES
BAR LIST
GENERAL LAYOUT
STRUCTURE BACKFILL & MECHANICAL TAMPING DIAGRAMS
BENDING DIAGRAMS (Dimensions o. to o. of bar)
GENERAL NOTES
COLORADO DEPARTMENT OF HIGHWAYS
GENERAL LAYOUT - BAR LIST SUMMARY & NOTES
STRUCTURE NO. J-9-AB


EXPANSION BEARING AT ABUT. 1.
FIXED BEARING AT ABUT. 4
PINTLE DETAIL
EXPANSION BEARING AT PIERS
PLAN WITHOUT CAP
SECTION "A-A"
SECTION "B-B"
SECTION C-C
CAST IRON CAP FOR POST
DIAPHRAGM - D1
DIAPHRAGM - D2
SECTION "M"
SECTION "N"
DETAIL OF 1" CHAMFER IN CURB AT SIDEWALK EXP'N. ANGLES
SECTION THRU CURB
LIST OF MATERIALS FOR EXPANSION DEVICE
DETAIL OF COVER PLATE AT PIERS
DETAIL OF SPLICE
SEC. Y-Y
SECTION THRU RDWY. EXPANSION DEVICE
SECTION "C-C"
COLORADO
DEPARTMENT OF HIGHWAYS
SUPERSTRUCTURE DETAILS
STRUCTURE NO. J-9-AB


REVISIONS
PLAN ABUT 4
PART ELEVATION-ABUT 4
PLAN-ABUT No. 1
ELEVATION- ABUT. No. 1
DETAIL of CAP at "A-A" ABUT NO. 1
DETAIL of CAP at "E-E" PIERS NO 2 & 3
HALF PLAN-BARS IN TOP
HALF PLAN-BAR IN BOTTOM
DIAGRAM OF BARS IN ABUTMENT CAPS
PLAN - PIER No. 2 AND 3
HALF PLAN BARS IN TOP
HALF PLAN BARS IN BOTTOM
DIAGRAM OF BARS IN PIER CAPS
ELEVATION of PIERS No. 2 AND 3
SECTION "E-E"
SECTION "H-H"
PLAN AT NECK
PLAN AT FOOTING
SECTION "A-A" ABUT No. 1
SECTION "G-G" PIER COL.
SECTION "B-B" ABUT. COL.
DETAIL of CAP at "D-D" ABUT. No. 4
SECTION "C-C" Abut. Cols.
SECTION "F-F" Pier Cols.
STRUCTURE NO. J-9-AB
COLORADO
DEPARTMENT OF HIGHWAYS
CONCRETE & I- BEAM BRIDGE
3 SPANS @ (46'-0", 57'-0", 46'-0")
30'-0" RDWY 2'-0" CURBS-60° SKEW
DETAILS OF ABUTS 1 & 4 PIERS 2 & 3



GENERAL LAYOUT

SUMMARY OF QUANTITIES

Item	Description	Unit	Super-structure	Abut. No.1	Pier No.2	Pier No.3	Abut. No.4	Totals
c	Unclassified Excavation	Cu. Yd.						146
	Common Excavation (Structural)	Cu. Yd.		62	29	29	66	186
	Structure Backfill (Class I)	Cu. Yd.		26	19	19	27	91
	Mechanical Tamping	Hrs.		6	2	2	6	16
	Station Yard Overhaul	Sta. Yd.						1000
	Yard Mile Overhaul	Yd. Mi.						30
	Treated Bridge Timber	Mft.bm.		.099			.099	.198
	Class "A" Concrete	Cu. Yd.	125.2	16.5	17.4	17.4	16.5	193
	Reinforcing Steel (incl. 1%± for overrun)	Lbs.	34,755	1,755	1,505	1,505	1,755	41,275
	Structural Steel (incl. ½%± for paint)	Lbs.	3,030		285	285		3,600
	Rip Rap (1'-6" thick)	Cu. Yd.		100			97	197
c	Metal Plate Guard Fence (Beam Type)	Lin. Ft.		25			25	50
x	Metal Plate Guard Rail (Beam Type)	Lin. Ft.	238					238
a	Drain Pipe (Conc. Floor 4"ϕ x 1'-6")	Each	12					12

BAR LIST SUPERSTRUCTURE

Mark	Size	No. Req'd	Length	Type	Dimensions ℓ	Dimensions m
401	½"ϕ	156	40'-0"	Str.		
402	½"ϕ	80	4'-2"	I	1'-1"	8"
403	½"ϕ	72	6'-3"	I	2'-3½"	6"
501	⅝"ϕ	112	27'-3"	II		
502	⅝"ϕ	111	28'-9"	III		
503	⅝"ϕ	111	26'-7"	Str.		
504	⅝"ϕ	417	7'-3"	IV		
505	⅝"ϕ	80	2'-11"	V		
701	⅞"ϕ	16	21'-9"	Str.		
1101	1¼"ϕ	24	41'-1"	Str.		
1102	1¼"ϕ	12	40'-5"	Str.		
1103	1¼"ϕ	18	31'-6"	Str.		
1104	1¼"ϕ	18	25'-0"	Str.		
1105	1¼"ϕ	18	18'-4"	Str.		
1106	1¼"ϕ	18	11'-0"	Str.		

SUMMARY

7023 Lin.Ft. ½"ϕ @ 0.668 lbs/lin.ft. = 4891 Lbs.
12451 Lin.Ft. ⅝"ϕ @ 1.043 lbs/lin.ft. = 12,986 Lbs.
348 Lin.Ft. ⅞"ϕ @ 2.044 lbs/lin.ft. = 711 Lbs.
3016 Lin.Ft. 1¼"ϕ @ 5.313 lbs/lin.ft. = 16,024 Lbs.
Plus 1%± for overrun = 343 Lbs.
Total = 34,755 Lbs.

BAR LIST - PIER No. 2 (PIER No. 3 SIMILAR)

Mark	Size	No. Req'd	Length	Type	Dimensions ℓ	Dimensions m
408	½"ϕ	12	7'-8"	I	1'-9"	1'-9"
409	½"ϕ	12	16'-9"	Str.		
410	½"ϕ	20	11'-0"	Str.		
411	½"ϕ	26	8'-4"	I	2'-1"	1'-9"
412	½"ϕ	12	8'-3"	IX		
509	⅝"ϕ	20	4'-6"	Str.		
510	⅝"ϕ	2	25'-4"	Str.		
602	¾"ϕ	16	13'-0"	Str.		
803	1"ϕ	2	16'-9"	Str.		
804	1"ϕ	12	3'-0"	VI		
901	1⅛"ϕ	2	25'-4"	Str.		
902	1⅛"ϕ	4	8'-8"	Str.		

SUMMARY

830 Lin.Ft. ½"ϕ @ 0.668 lbs/lin.ft. = 554 Lbs.
141 Lin.Ft. ⅝"ϕ @ 1.043 lbs/lin.ft. = 147 Lbs.
208 Lin.Ft. ¾"ϕ @ 1.502 lbs/lin.ft. = 312 Lbs.
70 Lin.Ft. 1"ϕ @ 2.670 lbs/lin.ft. = 187 Lbs.
85 Lin.Ft. 1⅛"ϕ @ 3.400 lbs/lin.ft. = 289 Lbs.
Plus 1%± for overrun = 16 Lbs.
Total = 1505 Lbs.

BAR LIST - ABUT. No. 1 (ABUT. No. 4 SIMILAR)

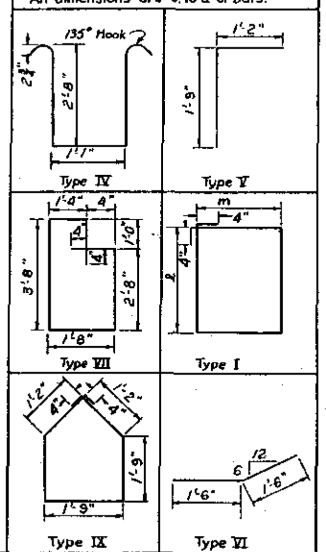
Mark	Size	No. Req'd	Length	Type	Dimensions ℓ	Dimensions m
404	½"ϕ	18	11'-4"	VII		
405	½"ϕ	8	4'-0"	Str.		
406	½"ϕ	6	4'-6"	Str.		
407	½"ϕ	4	3'-6"	Str.		
408	½"ϕ	26	7'-8"	I	1'-9"	1'-9"
505	⅝"ϕ	2	26'-7"	Str.		
506	⅝"ϕ	2	32'-10"	Str.		
507	⅝"ϕ	6	10'-0"	VIII		
508	⅝"ϕ	10	5'-6"	Str.		
509	⅝"ϕ	12	4'-6"	Str.		
601	¾"ϕ	24	13'-6"	Str.		
801	1"ϕ	4	32'-10"	Str.		
802	1"ϕ	4	26'-7"	Str.		

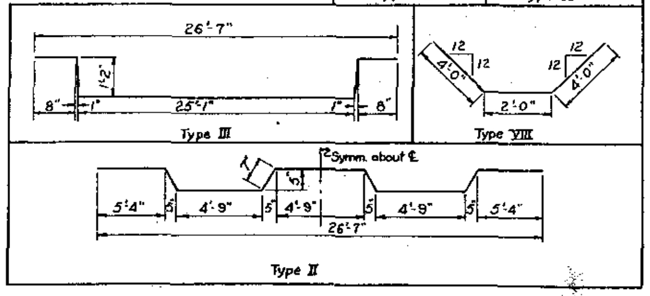
SUMMARY

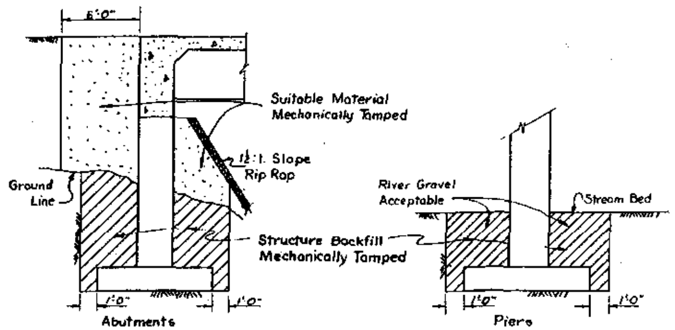
476 Lin.Ft. ½"ϕ @ 0.668 lbs/lin.ft. = 318 Lbs.
288 Lin.Ft. ⅝"ϕ @ 1.043 lbs/lin.ft. = 300 Lbs.
324 Lin.Ft. ¾"ϕ @ 1.502 lbs/lin.ft. = 487 Lbs.
238 Lin.Ft. 1"ϕ @ 2.670 lbs/lin.ft. = 635 Lbs.
Plus 1%± for overrun = 15 Lbs.
Total = 1755 Lbs.

BENDING DIAGRAMS

All dimensions are o. to o. of bars.

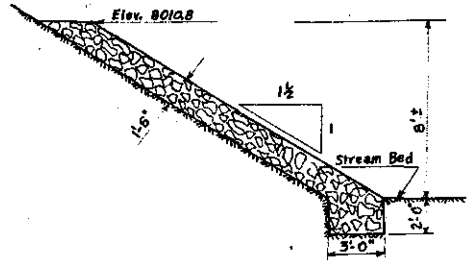






STRUCTURE BACKFILL & MECHANICAL TAMPING DIAGRAM

All material that is to be mechanically tamped, shall be placed in horizontal layers not more than 6 inches in depth and tamped before the next layer is placed.



DETAIL OF RIPRAP

FED. RD. DIV. No.	DISTRICT	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	S 0117 (3)	7	

GENERAL NOTES

ALL WORK SHALL BE DONE ACCORDING TO THE STANDARD SPECIFICATIONS OF THE COLORADO DEPARTMENT OF HIGHWAYS APPLICABLE TO THE PROJECT.

ALL CONCRETE SHALL BE CLASS "A" AND AIR ENTRAINED AS SPECIFIED.

ALL CONCRETE SURFACES EXPOSED TO NORMAL VIEW BY HIGHWAY TRAFFIC SHALL RECEIVE CLASS "2" SURFACE FINISH. WING FACES SHALL RECEIVE ORDINARY SURFACE FINISH.

CONCRETE GIRDERS, FLOOR SLABS, AND CURBS SHALL BE POURED MONOLITHICALLY.

FORMS FOR CONCRETE SURFACES EXPOSED IN THE FINISHED WORK SHALL BE CONSTRUCTED OF SHIPLAP OR TONGUE AND GROOVE LUMBER S 2 S UNLESS FACED WITH PANEL BOARD.

FOOTINGS IN ROCK SHALL BE POURED OUT TO ROCK AND NOT FORMED.

SOUNDINGS AND DEPTH OF FOOTING SHOWN ARE IN ACCORDANCE WITH THE BEST AVAILABLE DATA AND WHEN DIFFERENT CONDITIONS ARE ENCOUNTERED THE BRIDGE ENGINEER WILL INSPECT AND DETERMINE IF REDESIGN IS NECESSARY.

ALL REINFORCING STEEL SHALL CONFORM TO ASTM SPECIFICATION A 305-50T OR THE LATEST REVISION THEREOF, AND SHALL BE INTERMEDIATE GRADE STEEL OF A DEFORMED TYPE. EACH BAR SHALL BE TAGGED WITH THE NUMBER DESIGNATION AND THE STATION NUMBER OF THE PROJECT. PRIMARY BARS SHALL NOT BE SPLICED AND SECONDARY BARS WHEN SPLICED SHALL LAP 20 DIAMETERS OF THE BAR. DIMENSIONS FOR REINFORCING STEEL NOT SHOWN AS CLEAR SHALL BE TO THE CENTER LINE OF THE BAR.

ALL STRUCTURAL STEEL SHALL BE PAINTED ONE SHOP COAT OF ZINC CHROMATE AND TWO FIELD COATS OF ALUMINUM, UNLESS OTHERWISE NOTED, EXCEPT THE UNEXPOSED PORTION OF STEEL PILING NEED NOT BE PAINTED.

HANDRAIL BOLTS SHALL HAVE HEX HEADS, NUTS, AND LOCK WASHERS UNLESS OTHERWISE SPECIFIED AND ALL RIVETS, EXCEPT AS NOTED ARE ¾" DIA. AND SHALL BE POWER DRIVEN.

WHEN TREATED TIMBER OR PILING IS SHOWN ON THE DRAWING THE PRESERVATIVE FOR TREATMENT SHALL BE CREOSOTE OIL.

WHEN EXCAVATING FOR FOOTINGS THE FINAL ONE FOOT IN DEPTH SHALL BE DONE BY HAND LABOR METHODS.

IF BY PERMISSION OF THE ENGINEER PRIMARY BARS ARE SPLICED, THEY SHALL LAP 34 DIAMETERS, FOR BARS NEAR TOP OF BEAMS AND GIRDERS HAVING MORE THAN 12 INCHES OF CONCRETE UNDER THE BARS AND 20 DIAMETERS FOR BARS NEAR BOTTOM OF MEMBERS.

STRUCTURE NO. K-8-D

LOADING DATA

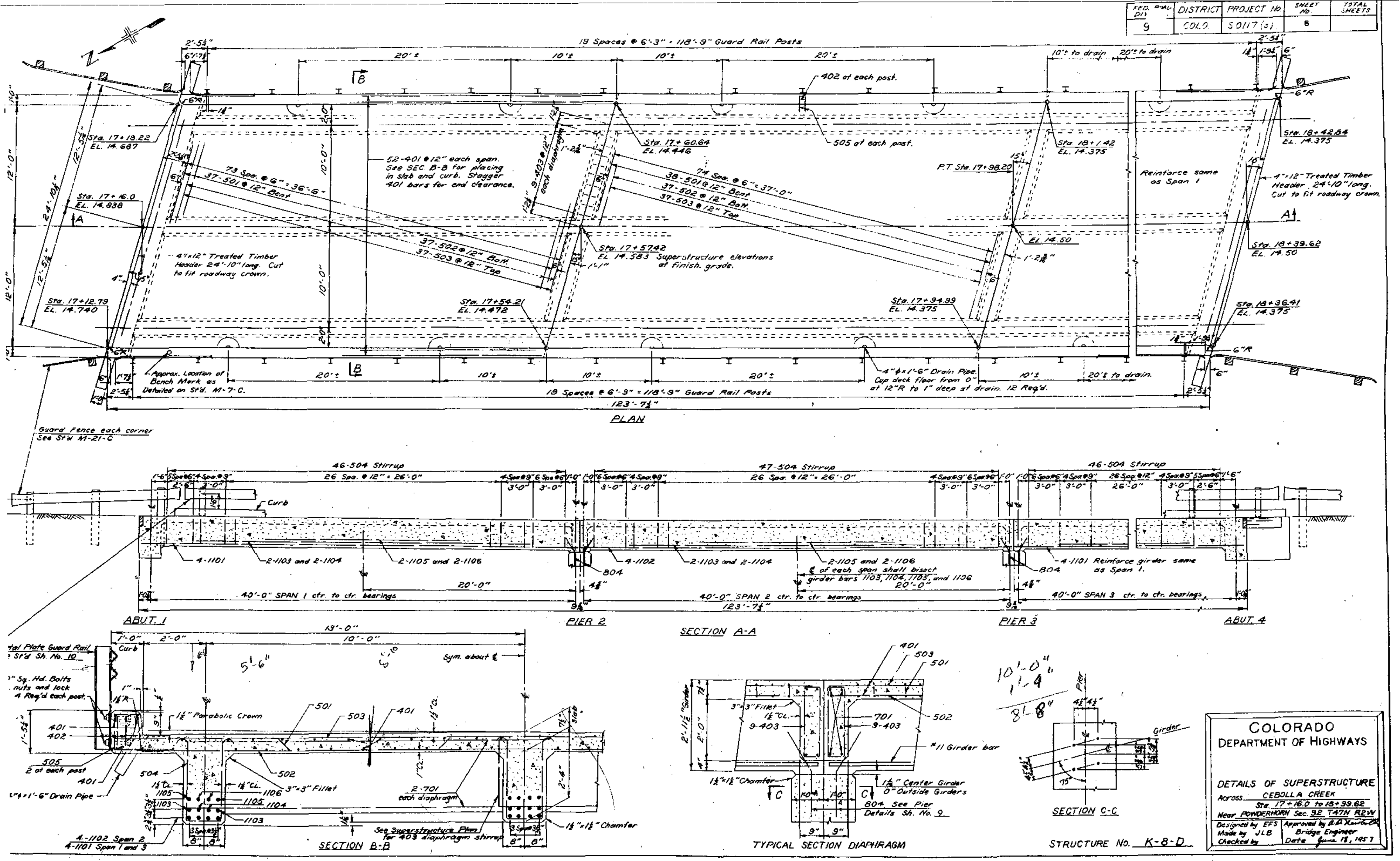
LIVE LOAD — A.A.S.H.O. (H20-S16-44)
DEAD LOAD ASSUMES 15 LBS. PER SQ. FT. ADDITIONAL WEARING SURFACE WHICH INCLUDES THE ½ INCH CONCRETE MONOLITHIC WEARING SURFACE SHOWN.

DESIGNING DATA

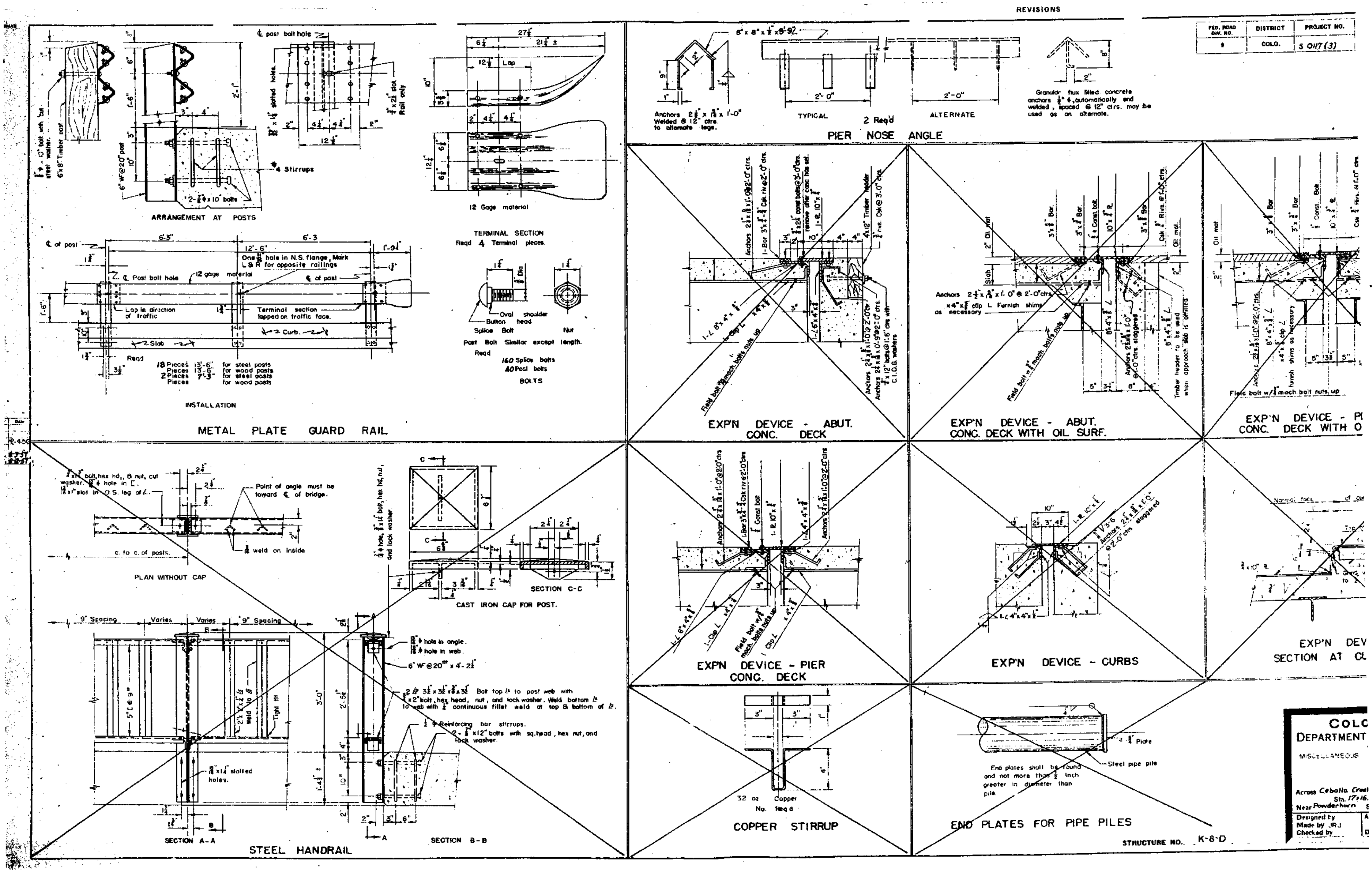
A.A.S.H.O. 1953 UNIT STRESSES, EXCEPT AS NOTED.
Reinforcing Steel fs = 20000 lbs. per sq. in.
Structural Steel fs = 18000 lbs. per sq. in.
fc = 1200 lbs. per sq. in.
n = 10

COLORADO DEPARTMENT OF HIGHWAYS
3 SPANS @ 40' CONCRETE SLAB & GIRDER BRIDGE. 24' RDWY. 1'-0" CURBS. 15° SKEW
GENERAL LAYOUT, BAR LISTS, TAMPING DIAGRAM, SUMMARY OF QUANTITIES.
Across Cebolla Creek
Sta. 17+16.0 to 18+39.62
Near Powderhorn Sec. 32 T. 47N. R. 2W.

Designed by E.F.S.	Approved by [signature]
Made by J.L.B.	Bridge Engineer
Checked by	Date: June 18, 1957



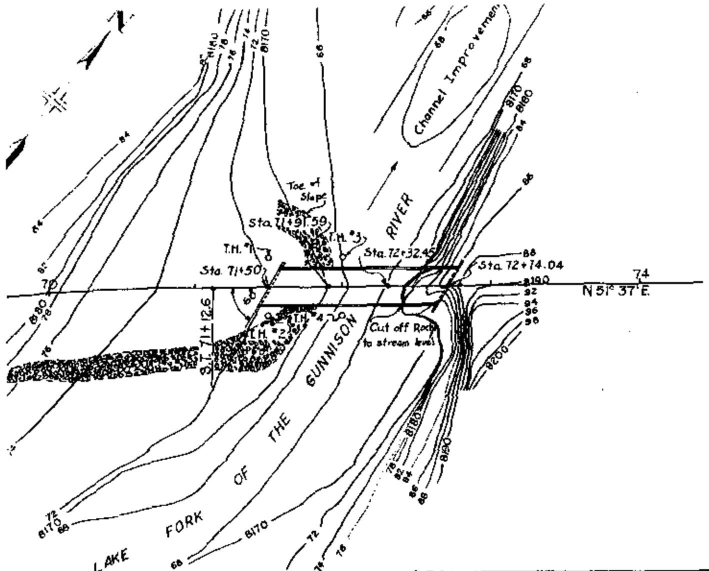
FED. ROAD DIV. 9
DISTRICT COLO.
PROJECT No. S 0117(3)
SHEET No. 8
TOTAL SHEETS
19 Spaces @ 6'-3" = 118'-9" Guard Rail Posts
402 at each post.
505 at each post.
Sta. 17+19.22 EL. 14.687
Sta. 17+16.0 EL. 14.838
Sta. 17+12.79 EL. 14.740
Sta. 17+60.64 EL. 14.446
Sta. 17+57.42 EL. 14.583 Superstructure elevations at finish grade.
Sta. 17+54.21 EL. 14.472
P.T. Sta. 17+98.20
Sta. 18+1.42 EL. 14.375
EL. 14.50
Sta. 17+94.99 EL. 14.375
Sta. 18+42.84 EL. 14.375
Sta. 18+39.62 EL. 14.50
Sta. 18+36.41 EL. 14.375
52-401 @ 12" each span. See SEC. B-B for placing in slab and curb. Stagger 401 bars for end clearance.
73 Spa. @ 6" = 36'-6"
37-501 @ 12" Bent
37-502 @ 12" Bott.
37-503 @ 12" Top
74 Spa. @ 6" = 37'-0"
38-501 @ 12" Bent
37-502 @ 12" Bott.
37-503 @ 12" Top
9-403 @ 12" each diaphragm
4"x12" Treated Timber Header 24'-10" long. Cut to fit roadway crown.
Reinforce same as Span 1
Approx. Location of Bench Mark as Detailed on St'd. M-7-C.
4" φ x 1'-6" Drain Pipe. Cup deck floor from 0" at 12"R to 1" deep at drain. 12 Req'd.
10'± to drain
20'± to drain.
123'-7½"
PLAN
Guard Fence each corner See St'd M-21-C
46-504 Stirrup
26 Spa. @ 12" = 26'-0"
47-504 Stirrup
Curb
4-1101
2-1103 and 2-1104
2-1105 and 2-1106
804
4-1102
℄ of each span shall bisect girder bars 1103, 1104, 1105, and 1106
4-1101 Reinforce girder same as Span 1.
20'-0"
40'-0" SPAN 1 ctr. to ctr. bearings
40'-0" SPAN 2 ctr. to ctr. bearings
40'-0" SPAN 3 ctr. to ctr. bearings
ABUT. 1
PIER 2
SECTION A-A
PIER 3
ABUT. 4
Metal Plate Guard Rail See St'd Sh. No. 10
Sq. Hd. Bolts nuts and lock 4 Req'd each post.
13'-0"
10'-0"
Sym. about ℄
1½" Parabolic Crown
501
503
401
402
505 2 at each post
504
502
3"x3" Fillet
1105
1103
1106
1104
2-701 each diaphragm
1½"x1½" Chamfer
4-1102 Span 2
4-1101 Span 1 and 3
4" φ x 1'-6" Drain Pipe
See Superstructure Plan for 403 diaphragm stirrup
SECTION B-B
3"x3" Fillet
9-403
701
#11 Girder bar
1½"x1½" Chamfer
1½" Center Girder 0" Outside Girders
804 See Pier Details Sh. No. 9
TYPICAL SECTION DIAPHRAGM
10'-0"
1'-4"
8'-8"
Pier
Girder
SECTION C-C
STRUCTURE No. K-8-D
COLORADO
DEPARTMENT OF HIGHWAYS
DETAILS OF SUPERSTRUCTURE
Across CEBOLLA CREEK
Sta. 17+16.0 to 18+39.62
Near POWDERHORN Sec. 32 T47N R2W
Designed by EFS
Made by JLB
Checked by
Approved by
Bridge Engineer
Date June 18, 1957

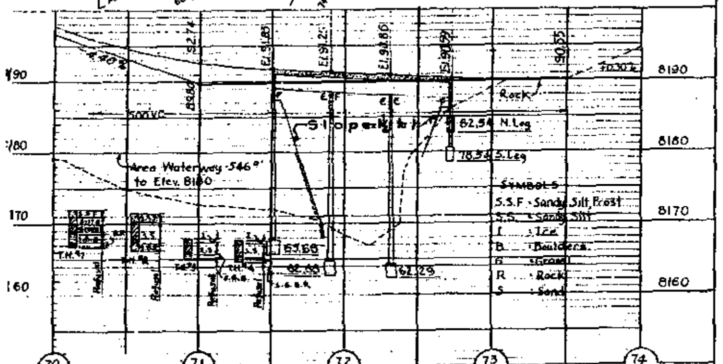


REVISIONS
FED. ROAD DIV. NO. | DISTRICT | PROJECT NO.
9 | COLO. | S 0117 (3)
ARRANGEMENT AT POSTS
6"x8" Timber post
6" WF @ 20# post
4 Stirrups
2-3/4"φ x 10" bolts
12 Gage material
TERMINAL SECTION
Reqd 4 Terminal pieces.
INSTALLATION
18 Pieces 13'-6" for steel posts
Pieces 13'-6" for wood posts
2 Pieces 7'-3" for steel posts
Pieces for wood posts
Splice Bolt
Nut
Post Bolt Similar except length.
160 Splice bolts
40 Post bolts
BOLTS
METAL PLATE GUARD RAIL
8" x 8" x 1/2" x 9'-9 1/2"
TYPICAL
2 Req'd
ALTERNATE
Granular flux filled concrete anchors 1/2"φ, automatically end welded, spaced @ 12" ctrs. may be used as an alternate.
PIER NOSE ANGLE
EXP'N DEVICE - ABUT. CONC. DECK
EXP'N DEVICE - ABUT. CONC. DECK WITH OIL SURF.
EXP'N DEVICE - PI CONC. DECK WITH O
PLAN WITHOUT CAP
Point of angle must be toward ℄ of bridge.
SECTION C-C
CAST IRON CAP FOR POST.
EXP'N DEVICE - PIER CONC. DECK
EXP'N DEVICE - CURBS
EXP'N DEV SECTION AT CU
SECTION A-A
STEEL HANDRAIL
SECTION B-B
COPPER STIRRUP
32 oz Copper
No. Req'd
End plates shall be found and not more than 1/2 inch greater in diameter than pile.
Steel pipe pile
END PLATES FOR PIPE PILES
STRUCTURE NO. K-8-D
COLO
DEPARTMENT
MISCELLANEOUS
Across Cebolla Creek
Near Powderhorn
Designed by
Made by JRJ
Checked by

FED. ROAD DIV. NO.	DISTRICT	PROJECT NO.	SHEET NO.	TOT. SHE
9	COLO.	SO 117(2)	8	

Rev. 6-27-56 JVG Bar bending diagram





GENERAL LAYOUT

BAR LIST-SUPERSTRUCTURE

Mark	Size	No. Req'd	Length	Type	Dimensions ℓ	m
460	½"φ	153	30'-0"	Str.		
461	½"φ	98	12'-0"	Str.		
462	½"φ	80	6'-1"	III	2'-3½"	6"
463	½"φ	55	11'-9"	Str.		
464	½"φ	24	21'-6"	Str.		
465	½"φ	108	1'-9"	IX	4"	1'-1"
466	½"φ	80	4'-0"	III	1'-1"	8"
501	⅝"φ	102	30'-7"	I		
502	⅝"φ	104	31'-9"	II		
503	⅝"φ	104	29'-9½"	Str.		
504	⅝"φ	417	7'-3"	VI		
505	⅝"φ	80	2'-11"	IX		
701	⅞"φ	16	24'-0"	Str.		
1101	1⅜"φ	24	43'-11"	VIII	41'-1"	
1102	1⅜"φ	12	43'-2½"	VIII	40'-4½"	
1103	1⅜"φ	18	31'-6"	Str.		
1104	1⅜"φ	18	25'-0"	Str.		
1105	1⅜"φ	18	18'-4"	Str.		
1106	1⅜"φ	18	11'-0"	Str.		

BAR SUMMARY-SUPERST'TURE

7,924 lin.ft. ½"φ @ 0.668#/lin.ft.= 5,293 lbs.
12,776 " " ⅝"φ @ 1.043 " " "=13,325 "
384 " " ⅞"φ @ 2.044 " " "= 785 "
3,118 " " 1⅜"φ @ 5.313 " " "=16,566 "

Plus 1% Overrun = 361 "
Total = 36,330 "

BAR LIST - PIER NO.2
(PIER NO.3 SAME)

Mark	Size	No. Req'd	Length	Type	Dimensions ℓ	m
402	½"φ	1	3'-0"	Str.		
403	½"φ	1	22'-9"	Str.		
404	½"φ	34	17'-0"	Str.		
405	½"φ	14	33'-0"	IV	16'-2"	0'-8"
406	½"φ	70	7'-4"	III	2'-1"	1'-3"
407 to 425	½"φ	1 ea.	8'-3" by 2.2" to 11'-6½"	V	1'-9¾" by ½" to 2'-6¼"	1'-8" by ½" to 2'-5"
426 to 444	½"φ	1 ea.	7'-4" by 2" to 10'-4"	III	1'-8" by ½" to 2'-5"	1'-8" by ½" to 2'-5"
445 to 451	½"φ	1 ea.	2'-4" by 1½" to 3'-1"	IV	0'-4	1'-8" by 1½" to 2'-5"
508	⅝"φ	28	5'-8"	Str.		
601	¾"φ	6	9'-9"	VII		
901	1⅛"φ	3	6'-6"	Str.		
902	1⅛"φ	4	29'-8"	Str.		
1001	1¼"φ	6	9'-0"	Str.		
1002	1¼"φ	4	29'-8"	Str.		
1003	1¼"φ	4	13'-7"	Str.		
1004	1¼"φ	4	18'-7"	Str.		
1101	1⅜"φ	16	4'-0"	Str.		
1102	1⅜"φ	8	22'-9"	Str.		

BAR SUMMARY – PIER NO.2
(PIER NO.3 SAME)

1954 lin.ft. ½"φ @ 0.668#/lin.ft = 1305 lbs
59 " " ¾"φ @ 1.502 " " " = 89 "
138 " " 1⅛"φ @ 3.400 " " " = 469 "
301 " " 1¼"φ @ 4.303 " " " = 1295 "
246 " " 1⅜"φ @ 5.313 " " " = 1307 "
159 " " ⅝"φ @ 1.043 " " " 166 "
Plus 1% Overrun = 44 "
Total 4675 "

BAR LIST-ABUTMENT NO. 4

Mark	Size	No. Req'd	Length	Type	Dims. ℓ	m
478	½"φ	2	5'-0"	Str.	(Field	bend)
479	½"φ	4	4'-0"	Str.	("	")
484	½"φ	2	2'-10"	Str.		
485	½"φ	2	3'-4"	Str.		
490	½"φ	7	4'-3"	Str.		
491	½"φ	6	5'-7"	Str.		
492	½"φ	7	4'-9"	Str.		
493	½"φ	14	2'-0"	Str.		
494	½"φ	2	7'-5½"	III	1'-8¾"	1'-8"
495	½"φ	2	7'-8½"	III	1'-10¼"	1'-8"
496 to 499	½"φ	1 ea.	7'-11½" by 3" to 8'-8½"	III	1'-11¾" by 1½" to 2'-4¼"	1'-8"
4100	½"φ	28	11'-0½"	X	2'-8¾"	9½"
4101	½"φ	2	12'-8½"	XI	2'-2¼"	
4102	½"φ	1	12'-10"	XI	2'-3"	
516	⅝"φ	2	36'-8"	Str.		
520	⅝"φ	7	6'-0"	Str.		
521	⅝"φ	4	10'-0"	Str.		
522	⅝"φ	11	5'-7"	Str.		
710	⅞"φ	3	10'-0"	Str.		
801	1"φ	4	29'-9"	Str.		
802	1"φ	3	32'-8"	Str.		
803	1"φ	1	36'-8"	Str.		

BAR SUMMARY-ABUT. NO.4

584 lin.ft. ½"φ @ 0.668#/lin.ft. = 390 lbs
216 " " ⅝"φ @ 1.043 " " " = 225 "
30 " " ⅞"φ @ 2.044 " " " = 61 "
254 " " 1"φ @ 2.670 " " " = 678 "

Plus 1% Overrun = 11 "
Total = 1365 "

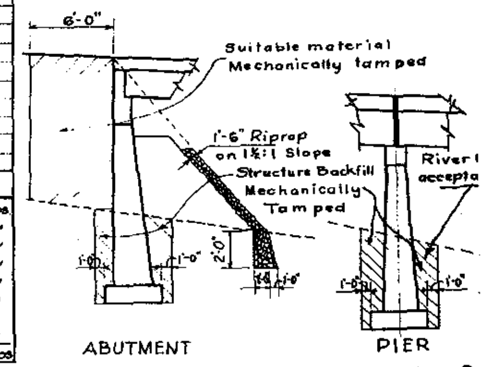
BAR LIST-ABUTMENT NO.1

Mark	Size	No. Req'd	Length	Type	Dimensions ℓ	m
470	½"φ	20	3'-0"	Str.		
471	½"φ	10	6'-2"	Str.		
472	½"φ	14	10'-5"	III	3'-2½"	1'-8"
473	½"φ	18	8'-5"	III	2'-2½"	1'-8"
474	½"φ	6	6'-5"	III	1'-2½"	1'-8"
475	½"φ	2	17'-6"	Str.		
476	½"φ	15	6'-4"	III	1'-8"	1'-2"
477	½"φ	29	11'-1½"	X	2'-10¾"	8½"
478	½"φ	2	5'-0"	Str.	(Field	bend)
479	½"φ	4	4'-0"	Str.	(Field	bend)
480	½"φ	1	3'-0"	Str.		
481	½"φ	1	3'-6"	Str.		
482	½"φ	1	12'-9½"	XI	2'-2¾"	
483	½"φ	2	13'-3"	XI	2'-5½"	
484	½"φ	1	2'-10"	Str.		
485	½"φ	1	3'-4"	Str.		
511	⅝"φ	14	6'-2"	Str.		
512	⅝"φ	8	3'-7"	Str.		
513	⅝"φ	4	22'-0"	Str.		
514	⅝"φ	4	15'-9"	Str.		
515	⅝"φ	4	8'-9"	Str.		
516	⅝"φ	2	36'-8"	Str.		
601	¾"φ	6	9'-9"	VII		
602	¾"φ	20	8'-7"	Str.		
603	¾"φ	8	6'-2"	Str.		
705	⅞"φ	8	17'-6"	Str.		
801	1"φ	4	29'-9"	Str.		
802	1"φ	3	32'-8"	Str.		
803	1"φ	1	36'-8"	Str.		
905	1⅛"φ	8	3'-7"	Str.		
906	1⅛"φ	4	22'-0"	Str.		
907	1⅛"φ	4	13'-9"	Str.		
908	1⅛"φ	4	9'-5"	Str.		

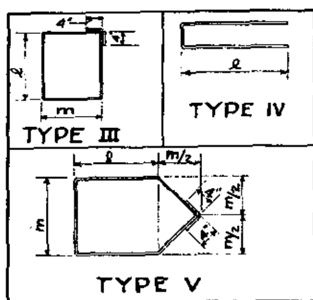
BAR SUMMARY-ABUT. NO.1

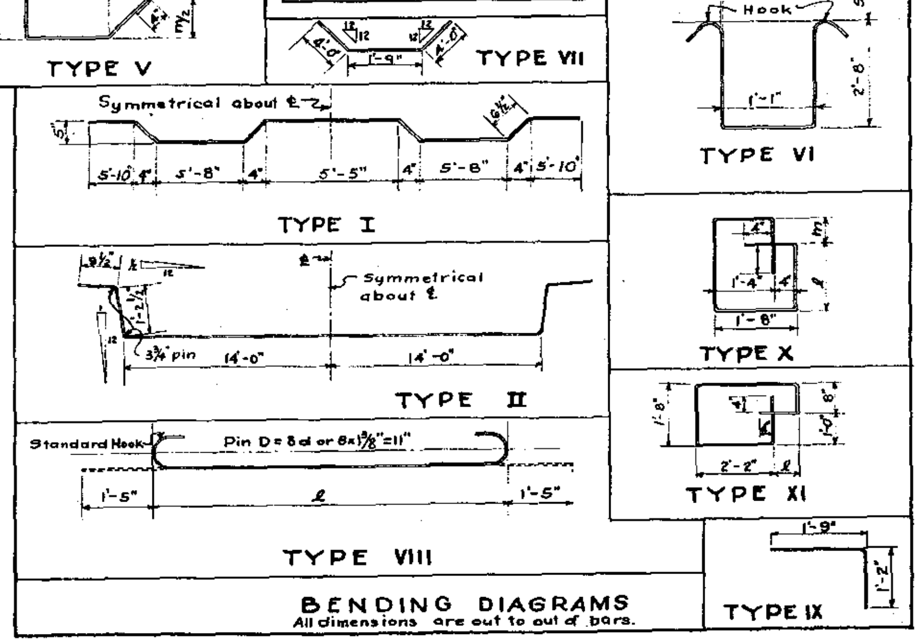
988 Lin.ft. ½"φ @ 0.668#/ft. = 660 lbs.
374 " " ⅝"φ @ 1.043 " " = 390 "
280 " " ¾"φ @ 1.502 " " = 421 "
140 " " ⅞"φ @ 2.044 " " = 286 "
254 " " 1"φ @ 2.670 " " = 678 "
209 " " 1⅛"φ @ 3.400 " " = 711 "

Plus 1% Overrun 30 "
Total = 3175 lbs



STRUCTURE BACKFILL & MECHANICAL TAMPING DIAGRA





BENDING DIAGRAMS
All dimensions are out to out of bars.

SUMMARY OF QUANTITIES

Item	Description	Unit	Superstr.	Abut.#1	Pier#2	Pier#3	Abut.#4	Total
4a	Dry Rock Excavation (Str.)	Cu. Yd.					13	13
4b	Dry Common Excavation (Str.)	Cu. Yd.		39	11	25	13	88
4c	Wet Rock Excavation (Str.)	Cu. Yd.		11	10	14		35
4d	Wet Common Excavation (Str.)	Cu. Yd.			24	24		48
6a	Structure Backfill	Cu. Yd.		34	32	43	19	128
6c	Mechanical Tamping	Hrs.		20	3	4	5	32
13c	Unclassified Excavation	Cu. Yd.						500
8a	Station Yard Overhaul	Sta. Yd.						1408
8b	Yard Mile Overhaul	Yd. Mi.						233
2b	Treated Bridge Timber	M ft. b.m.	0.288	0.112			0.112	0.512
6a	Class "A" Concrete	Cu. Yd.	127	29	30	29	15	230
17	Reinforcing Steel (+1% overrun)	Lbs.	36,330	3175	4675	4675	1365	50,220
18	Structural Steel (+½% for Paint)	Lbs.	3,560		505	505		4570
7a	Rip Rap (1'-6" thick)	Cu. Yd.		180				180
5a	Metal Plate Guard Fence (Beam Type 2)	Lin. ft.	288					288
0c	Sheet Copper (32 oz.)	Lbs.	8					8
19a	Drain Pipe (Conc. Floor)(4"φ x 1'-6")	Each	6					6
	1" Expansion Joint Mat'l Type I	Sq. ft.	136					136

Structural Steel includes 2575 lbs. of Handrail Steel.
Expansion Joint Material shall be included in bid price of Class "A" Concrete and shall be according to AASHO specifications M-153-54.

GENERAL NOTES

ALL WORK SHALL BE DONE ACCORDING TO THE STANDARD SPECIFICATIONS OF THE COLORADO DEPARTMENT OF HIGHWAYS APPLICABLE TO THE PROJECT.
ALL CONCRETE SHALL BE CLASS "A" AND AIR ENTRAINED AS SPECIFIED
ALL CONCRETE SURFACES EXPOSED TO VIEW SHALL RECEIVE CLASS "I" SURFACE FINISH, EXCEPT THE UNDERSIDE OF FLOOR SLABS AND ABUTMENT FACES BETWEEN OUTSIDE STRINGERS.
CONCRETE GIRDERS, FLOOR SLABS, AND CURBS SHALL BE POURED MONOLITHICALLY.
FORMS FOR CONCRETE SURFACES EXPOSED IN THE FINISHED WORK SHALL BE CONSTRUCTED OF SHIPLAP OR TONGUE AND GROOVE LUMBER S 3 S UNLESS FACED WITH PANEL BOARD.
FOOTINGS IN ROCK SHALL BE POURED OUT TO ROCK AND NOT FORMED.
SOUNDINGS AND DEPTH OF FOOTING SHOWN ARE IN ACCORDANCE WITH THE BEST AVAILABLE DATA AND WHEN DIFFERENT CONDITIONS ARE ENCOUNTERED THE BRIDGE ENGINEER WILL INSPECT AND DETERMINE IF REDESIGN IS NECESSARY.
ALL REINFORCING STEEL SHALL CONFORM TO ASTM SPECIFICATION A 305-50T OR THE LATEST REVISION THEREOF, AND SHALL BE INTERMEDIATE GRADE STEEL OF A DEFORMED TYPE. EACH BAR SHALL BE TAGGED WITH THE NUMBER DESIGNATION AND THE STATION NUMBER OF THE PROJECT. PRIMARY BARS SHALL NOT BE SPLICED AND SECONDARY BARS WHEN SPLICED SHALL LAP 20 DIAMETERS OF THE BAR. DIMENSIONS FOR REINFORCING STEEL NOT SHOWN AS CLEAR SHALL BE TO THE CENTER LINE OF THE BAR.
ALL STRUCTURAL STEEL SHALL BE PAINTED ONE SHOP COAT OF ZINC CHROMATE AND TWO FIELD COATS OF ALUMINUM, UNLESS OTHERWISE NOTED, EXCEPT THE UNEXPOSED PORTION OF STEEL PILING NEED NOT BE PAINTED.
HANDRAIL BOLTS SHALL HAVE HEX HEADS, NUTS, AND LOCK WASHERS UNLESS OTHERWISE SPECIFIED AND ALL RIVETS, EXCEPT AS NOTED ARE ¾" DIA. AND SHALL BE POWER DRIVEN.
WHEN TREATED TIMBER OR PILING IS SHOWN ON THE DRAWING THE PRESERVATIVE FOR TREATMENT SHALL BE CREOSOTE OIL.
WHEN EXCAVATING FOR FOOTINGS THE FINAL ONE FOOT IN DEPTH SHALL BE DONE BY HAND LABOR METHODS.

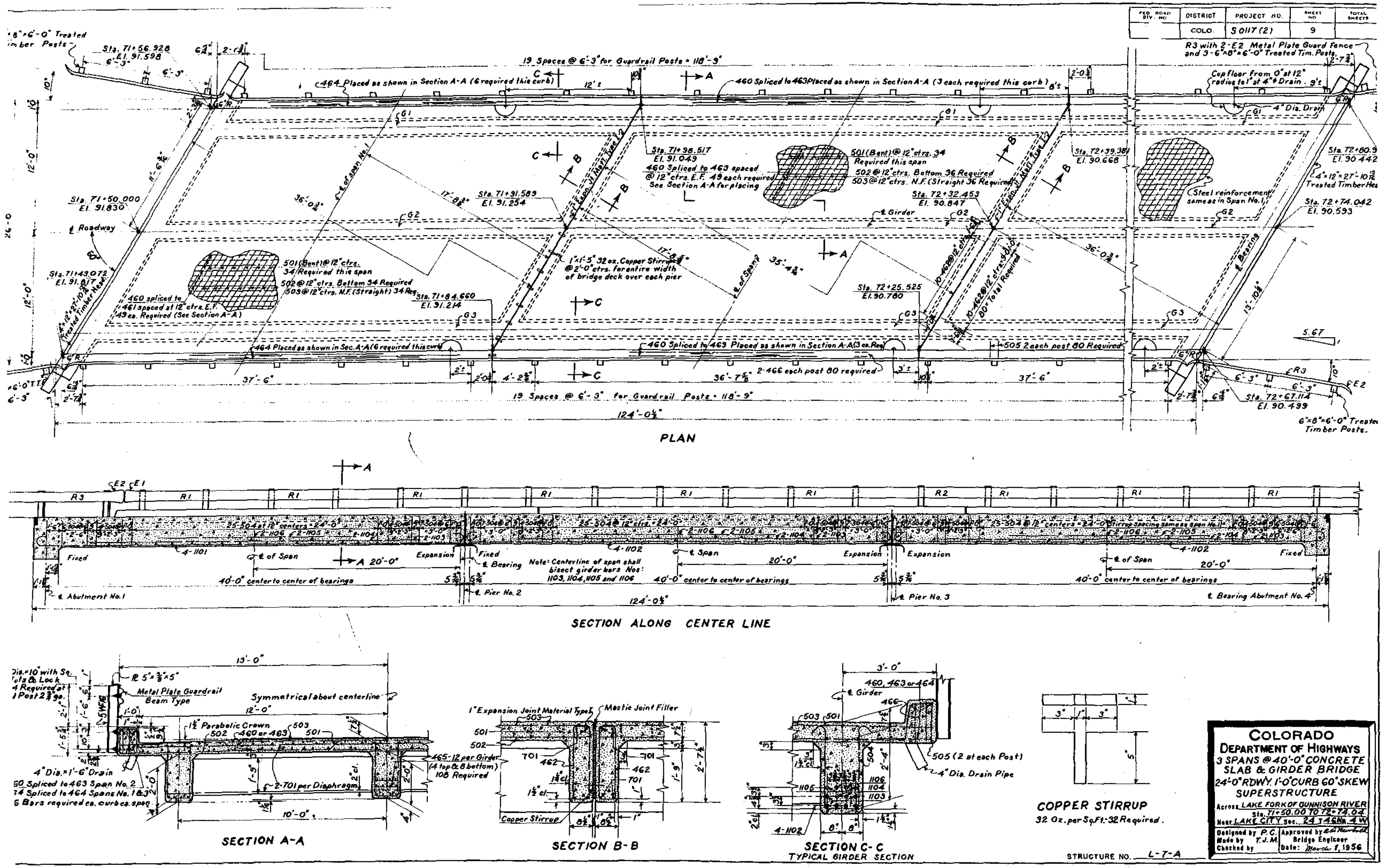
STRUCTURE NO. L-7-A

LOADING DATA
LIVE LOAD – A.A.S.H.O. (H-20-44)
DEAD LOAD ASSUMES 15 LBS. PER SQ. FT. ADDITIONAL W SURFACE WHICH INCLUDES THE 1½ INCH CONCRETE MONO WEARING SURFACE SHOWN.

DESIGNING DATA
A.A.S.H.O. 1953 UNIT STRESSES, EXCEPT AS NOTED.
Reinforcing Steel fs 20000 lbs. per sq. in.
Structural Steel fs 18000 lbs. per sq. in.
fc 1200 lbs. per sq. in.
n 10

COLORADO
DEPARTMENT OF HIGHWAYS
3 SPANS @ 40'-0" CONCRETE SLAB
4 GIRDER BRIDGE
24'-0" RDWY 1'-0" CURB 60° SKEW
GENERAL LAYOUT
Across Lake Fork of the Gunnison River
Sta. 71+50.00 to 72+74.04
Near Lake City Sec. 24 T.46 N. R.4

Designed by P.C.	Approved by [signature]
Made by A.E.S.	Bridge Engineer
Checked by	Date: March 8, 1956


FED. ROAD DIV. NO.
DISTRICT
PROJECT NO.
SHEET NO.
TOTAL SHEETS
COLO.
S 0117 (2)
9
PLAN
SECTION ALONG CENTER LINE
SECTION A-A
SECTION B-B
SECTION C-C
TYPICAL GIRDER SECTION
COPPER STIRRUP
32 Oz. per Sq.Ft.-32 Required.
COLORADO
DEPARTMENT OF HIGHWAYS
3 SPANS @ 40'-0" CONCRETE SLAB & GIRDER BRIDGE
24'-0" RDWY. 1'-0" CURB 60° SKEW
SUPERSTRUCTURE
Across LAKE FORK OF GUNNISON RIVER
Sta. 71+50.00 TO 72+74.04
Near LAKE CITY Sec. 24 T 46N R 4 W
Designed by P. C.
Made by T. J. M.
Checked by
Approved by
Bridge Engineer
Date: March 1, 1956
STRUCTURE NO. L-7-A