Chapter 4
Bridge Program Drawings

Section 4.01 - Preliminary

Introduction

Once the location, site characteristics, and hydraulic requirements have been determined, the new structure type and size can be established and a Structure Selection Report is written. If an existing structure can be adequately rehabilitated at an effective cost, a Structure Rehabilitation Report is written after determining the work required to rehabilitate the structure.

Preliminary Types

Preliminary layouts are generated based on the structure selected and the rehabilitation work required. The Bridge Program uses three types of preliminary layouts: the Preliminary Geology Layout, the Preliminary Layout, and the Preliminary Railroad Site Layout.

The **PRELIMINARY GEOLOGY LAYOUT** consists of the plan for the new bridge, the profile grade and ground line, and general information. The Geology Program will use this information to drill test holes at the structure site for foundation investigations. The Log Boring Sheet and the Geology Report are then generated by the Geology Program (see Section 4.06 - Geology) and transmitted to the Bridge Program.

The **PRELIMINARY LAYOUT** is required for new bridges, new culverts, bridge widenings, and culvert extensions. Plans for widenings are laid out to match the as-constructed plans, regardless of the stationing direction of the new survey. The Preliminary Layout consists of the following pertinent information for the proposed structure: plan and elevation, typical bridge/culvert and roadway section(s), structure data, and stream data. Additional details required for bridges are grade and curve data. Horizontal curve data is also included for culverts. If applicable, the FHWA and/or the Irrigation Company reviews the layout, and upon approval, returns an approval letter to the Bridge Program.

The **PRELIMINARY RAILROAD SITE LAYOUT** consists of a plan of the proposed substructure in relation to the railroad facilities. Site layouts shall incorporate either a scaled aerial

photograph or mapping. The US DOT Number for railroad bridges, which may be obtained from the Utilities Section, shall be included on this layout. This layout should be done early in the design process to allow time for the approval of or changes required by the railroad. This layout shall also be included as a reference sheet in the final set of plans for bridges over the Union Pacific Railroad.

A **TRACK PROFILE(S)** sheet shall accompany the Preliminary Railroad Site Layout for bridges over the Union Pacific Railroad. This sheet shows the vertical relationship between the bridge and the railroad tracks. This sheet shall also be included as a reference sheet in the final set of plans.

In addition to the Track Profile(s) sheet, the Union Pacific Railroad requires completion of an **OVERHEAD SUBMITTAL CHECK-LIST. DRAINAGE DETAILS** shall be provided as necessary.

A preliminary Title Sheet, marked "**PRELIMINARY**", and a General Notes sheet shall accompany each Preliminary Layout sheet. A Log Boring Sheet is also required on structures involving the FHWA or the railroad. Only a preliminary Title Sheet marked "PRELIMINARY" and a General Notes sheet are required for each rehabilitation project. Preliminary details for rehabilitation projects do not require a preliminary drawing number.

General Design and Detail Information

Prior to commencing the design, Bridge Program personnel should review information from the following sources: Field, Hydraulic Section, Geology Program, Project Development Program, Materials Program, Right-of-Way Program, and Utilities Section.

Field information includes **ENGINEER'S RECOMMENDATIONS** and **FIELD SURVEY NOTES**. Engineer's Recommendations are either formal recommendations submitted by the Resident Engineer with the approval of both the District Construction Engineer and the District Engineer or informal recommendations from A-11's, telephone conversations, e-mails, and personal contact with the Resident or Project Engineer during project administration and detailing. Field Survey Notes vary in content and contain actual information determined from site surveys and is generally requested by the Squad Team Leader. For bridge widenings, actual elevations and dimensions shall be requested early in the design phase for adequate planning preparation.

Information on existing stockpass structures or requirements for new stockpasses is the Resident Engineer's responsibility and should be included in the Engineer's Recommendations.

Hydraulic information includes the **HYDRAULIC REPORT** and the **SCOUR REPORT**. The Hydraulic Report may include general stream and site information, flood history and method of analysis, and specific information for different structure options. The Scour Report determines the depth and susceptibility to scour at a given site. Typically, the Scour Report is part of the Hydraulic Report.

Information from the Geology Program includes the **LOG BORING SHEET, GEOLOGY REPORT**, the **SCOUR GRADATION ANALYSIS**, and the **SEISMIC REPORT**. For information on these reports see Section 4.06 - Geology.

The Project Development Program supplies **ROAD PLANS** and **CROSS SECTIONS**. Road Plans contain the general layout of the area including right-of-way boundaries and utilities, road grades, road alignment, and typical roadway sections. Cross Sections contain top of earth work elevations (or similar elevations) at centerline profile, side slopes for the safety section, and back slope transitions to natural ground.

Materials Program information includes the **ALKALI REPORT**, which gives the sulphate and pH content of the soil in the vicinity of the structure. For Corrosion Resistance Table, see Section 4.02 -General Notes.

Information from the Right-of-Way Program consists of right-of-way recommendations for types and locations of special use structures.

Prior to a utility survey, utilities information can be obtained from the Utilities Section. Initial utility surveys will be done by the Field and plotted on Right-of-Way and Utility Plans by the Project Development Program. After railroad approval of the Preliminary Railroad Site Layout and Preliminary Layout, the Utilities Section shall contact the railroad company and railroad property tenants concerning construction around railroad facilities or utilities on railroad property.

The **PLAN** describes the size and layout of the structure in relation to the centerline survey or construction and the channel, railroad, and/or road it crosses.

RIPRAP LENGTHS are detailed in the plan of the Preliminary Layout. Riprap recommendations may be obtained from the Hydraulic Section by specific request.

The **SKEW AND COMPLEMENT** to the major feature(s) intersected shall be shown. Show the skew and complement to the substructure if different.

TEST HOLES are located and plotted on the plan of the Preliminary Layout.

The intersected station of centerline survey and the major element to be crossed must be called out in the plan and also noted as the location of the structure in the Title Block. The substructure stations are called out in the plan unless a working line is required, in which case the sketches in Section 4.03 - General Plan and Elevation shall apply. Stationing shall increase from left to right on the sheet, except in the case of widenings in which stationing shall follow the existing GP&E.

The **ELEVATION** on the Preliminary Layout for a bridge describes the bridge by showing various structure components projected from the plan along centerline bridge roadway. The skew shall not be reflected in the elevation. The bridge superstructure, substructure, and approach slabs are shown in this elevation. **FINISHED GRADE ELEVATIONS** at rear face abutments are shown along with the bridge grade. If the bridge is designed on a vertical curve, the bridge grade shall be indicated as "Grade on vertical curve". If the bridge is straight-lined between two points on a vertical curve, the bridge grade shall be shown. Existing and proposed ground line and water elevations are shown as they appear along centerline survey or working line.

The **LONGITUDINAL SECTION** on the Preliminary Layout for a culvert shows the culvert's longitudinal section, flow line elevations, and the culvert's slope.

The **ELEVATION** on the Preliminary Geology Layout includes existing ground line at centerline survey or working line, profile grade, and a stick type configuration for structures.

Significant **CHANNEL EXCAVATION**, upstream or downstream from the structure, is not required unless it is called out on the Structure Selection Report, which shall be based on hydraulic recommendations. The material shown within the limits of the proposed channel cross section and the existing ground line

shall be labeled as to whether it is to be removed or remain in place. Typically, the hydraulic analysis is based on the material remaining in place.

A **SECTION** is cut through the bridge looking ahead station on the plan and is included on the Preliminary Layout. This typical section through the slab defines the clear roadway, girder spacing, and sidewalk widths as well as the bridge deck cross slopes. A section is cut through the culvert to show the number and size of the barrels.

Other details shown on the Preliminary Layout sheet for bridges are the **GRADE DATA** and **HORIZONTAL CURVE DATA** (when on horizontal curve). The Preliminary Layout sheet for culverts will include the Horizontal Curve Data.

Information will be shown on the sheet with the bridge located in its approximate position (often the curves are exaggerated for clarity). A **TYPICAL ROADWAY SECTION** is also shown. The Project Development Program provides this information on the Preliminary Plans.

STRUCTURE DATA for the Preliminary Layout is established from the Engineer's preliminary length determination, Project Development Plans, and correspondence in the project file and by using the example drawings as a guide.

The Hydraulic Report provides **STREAM DATA** for the Preliminary Layout, if applicable.

Structure Types

Based on the preceding information, the Bridge Program determines the type of structure to be used at a site. The following tables of **GENERAL CHARACTERISTICS** and **STRUCTURAL CHARACTERISTICS** for the most common bridge types are furnished as a guide for structure lengths.

General Characteristics				
Girder Type	Cost	Maintenance	Construction	Appearance
Rolled Beam Girder (Non-Composite)	Requires more steel than composite rolled beam girders but requires practically no shop fabrication, hence net cost may not be as much. Most competitive in short span range.	Some painting of girders.	Details and form work simple.	Weathering Steel Paint
Rolled Beam Girder (Composite)	Requires more steel than composite welded plate girders but requires little shop work. Net cost may compare with welded plate girders for short spans.	Some painting of girders.	Details and form work simple.	Weathering Steel Paint
Welded Plate Girder (Non-Composite)	Slightly higher than composite welded plate girders because more steel is required, though cost of connectors may offset the difference.	Some painting of girders and repair of expansion devices if used.	Details and form work simple. All shop fabricated.	Weathering Steel Paint
Welded Plate Girder (Composite)	May compete with T-girders and box girders in the longer spans. Connectors over supports add little to savings; therefore they are generally not used. Not as economical in continuous spans as in simple spans.	Some painting of girders and repair of expansion devices.	Details and form work simple. All shop fabricated. Transportation of girders may be a problem with connectors attached to the girders.	Weathering Steel Paint

General Characteristics				
Girder Type	Cost	Maintenance	Construction	Appearance
Prestressed-Precast Concrete Girders	May be competitive with steel girders.	Low cost.	Fabrication plants in Denver, Billings, Salt Lake City, and other areas. Fabrication more complicated than reinforced concrete. Requires careful handling after fabrication on ground at job site.	Some made with bulbous bottom, which is not as neat as straight stem, although acceptable. Colored concrete Textured surface
Prestressed-Precast Concrete Tri-Deck Girder	May be competitive with steel girders. Top flange used as deck. Shipping cost are typically higher than steel girders due to larger section weight.	Low cost. May need to maintain longitudinal joint girder sections.	Fabrication plants in Denver, Billings, Salt Lake City, and other areas. Fabrication more complicated than reinforced concrete. Requires careful handling after fabrication on ground at job site.	Colored concrete Paint or stain Textured surface
Prestressed-Precast Concrete Deck Bulb T Girders	May be competitive with steel girders. Top flange used as deck. Shipping cost are typically higher than steel girders due to larger section weight.	Low cost. May need to maintain longitudinal joint girder sections.	Fabrication plants in Denver, Billings, Salt Lake City, and other areas. Fabrication more complicated than reinforced concrete. Requires careful handling after fabrication on ground at job site.	Colored concrete Paint or stain Textured surface
Prestressed-Precast Concrete Twin T Girders	May be competitive with steel girders. Top flange used as deck. Shipping cost are typically higher than steel girders due to larger section weight.	Low cost. May need to maintain longitudinal joint girder sections.	Fabrication plants in Denver, Billings, Salt Lake City, and other areas. Fabrication more complicated than reinforced concrete. Requires careful handling after fabrication on ground at job site.	Colored concrete Paint or stain Textured surface

General Characteristics				
Girder Type	Cost	Maintenance	Construction	Appearance
Prestressed-Precast Concrete I-Girders	May be competitive with steel girders. Shipping cost are typically higher than steel girders due to larger section weight.	Low cost.	Fabrication plants in Denver, Billings, Salt Lake City, and other areas. Fabrication more complicated than reinforced concrete. Requires careful handling after fabrication on ground at job site.	Colored concrete Paint or stain Textured surface
Prestressed-Precast Concrete I-Girders (Composite)	May be competitive with steel girders. Shipping cost are typically higher than steel girders due to larger section weight.	Low cost.	Fabrication plants in Denver, Billings, Salt Lake City, and other areas. Fabrication more complicated than reinforced concrete. Requires careful handling after fabrication on ground at job site.	Colored concrete Paint or stain Textured surface

Structural Characteristics - Steel Girders					
Girder Type	Most Economical Depth-To-Span Ratios For Continuous Spans		Most Economical Depth-To-Span Ratios For Simple Spans		Remarks
	Grade 36	Grade 50	Grade 36	Grade 50	
Rolled Beam Girder (Non-Composite)	0.055	0.050	0.075	0.070	Used for simple and continuous spans. Applicable for spans 30'-0" to 65'-0".
Rolled Beam Girder (Composite)	0.050	0.045	0.060	0.055	Lends better to simple spans than continuous spans. Can be used in place of welded plate girders or T-girders for spans less than 80'-0".
Welded Plate Girder (Non-Composite)	0.055	0.050			Lends well to continuous spans.
Welded Plate Girder (Composite)	0.050	0.045	0.060	0.055	Lends better to simple spans than continuous spans.

Structural Characteristics - Prestressed-Precast Concrete Girders		
Girder Type	Most Economical Depth-To-Span Ratios	Remarks
I-Girder With Cast-In-Place Deck	May be as high as 0.065 and as low as 0.043.	Applicable for spans 60'-0" to 140'-0". Standard forms stocked by fabricators.
Tri-Deck Section	May be as low as 0.041.	Applicable for spans up to 55' - 0".
Bulb T Sections	Ranges from 0.035 to 0.065	Applicable for spans 45'-0 to 130'-0".
Twin T Sections	May be as low as 0.047.	Applicable for spans up to 65'-0".
Twin T Girder with Cast-In-Place Deck	May be as low as 0.047.	Applicable for spans up to 65'-0".

Note: Standard girders are preferred; special sections are more expensive. These are generally used as simple spans but can be made continuous for live load and require detailed design, often accomplished by the Fabricator. Section depth-to-span ratio when there is no cast-in-place deck. Girder depth is used for depth-to-span ratio when there is a cast-in-place deck.

Cells

Name	Description
GPBARR	Barrier Rail for GP&E
GPCORR	Corrugated Rail for GP&E
GPPED4	Rail Ped Rail for GP&E
GPPED5	Rail Ped Raft for GP&E
GPRAIL	Rail for GP&E Section A-A
HPPLANH	Pile Plan Hidden
PLUS	Plus Symbol for Title Sheet
PREGEN	Prelim General Notes Sheet
PREGx	Prelim Geology Layout Sheet where x is the sheet scale (1, 10, 15, 20, 25, 30, 40, 50, & 60)
PRESHEET	Prelim Layout Sheet
PRETITLE	Prelim Title Sheet
Q100	High Water Q_{100} Note
Q25	High Water Q_{25} Note
Q50	High Water Q_{50} Note
RETWALL	Retaining Wall Design Data Table
RFELE	Elev in Box
RRELEV	Railroad Elevation for GP&E
RRGHO2	Ghosted Railroad Pattern for PGL
RRSQL2	Solid Railroad Pattern for PGL
SCALE	Scale for GP&E Elev
SDB	Stream Data for Bridge
SDBCD	Stream Data for Bridge Canal & Ditch
SDC	Stream Data for Culvert
SDCCD	Stream Data for Culvert Canal & Ditch

Preliminary Geology Layout Checklist

Plan

- ❑ Detail to Scale
- ❑ Centerline Survey w/Stationing and Bearing
- ❑ Centerline Survey at Cross Road w/Stationing and Bearing
- ❑ Centerline Bridge Roadway (may be concurrent w/Centerline Survey)
- ❑ Centerline Feature Intersected/Structure/Bents/Piers
- ❑ Working Line/Construction Line Call-out
- ❑ Skew and Complement at Centerline Feature Intersected (also show at substructure if different)
- ❑ Longitudinal Dimensions
- ❑ Channel Bottom Dimension
- ❑ Centerline Bridge Roadway/Survey/Working Line to Edge of Deck Dimension(s)
- ❑ Offsets (throw on curve)
- ❑ Station Call-outs at Substructures/Structure/Feature Intersected
- ❑ Flow Arrow w/Name of Channel
- ❑ North Arrow
- ❑ Utilities
- ❑ To X (destinations)
- ❑ Existing Structure Call-out
- ❑ Scale Call-out
- ❑ Line Styles

Elevation

- ❑ Detail to Scale/Projected from Plan
- ❑ Grade/Vertical Curvature Call-out
- ❑ Profile Grade Call-out
- ❑ Existing Ground Line Call-out w/Symbols
- ❑ Elevations
- ❑ Scale Call-out
- ❑ Stationing

Remarks

- ❑ Obtain Alkali Sample
- ❑ Obtain Necessary Foundation Information to Complete LRFD Design

Preliminary Bridge Layout Checklist

Plan

- ❑ Detail to Scale
- ❑ Centerline Survey w/Stationing and Bearing
- ❑ Centerline Survey at Cross Road w/Stationing and Bearing
- ❑ Centerline Bridge Roadway (may be concurrent w/Centerline Survey)
- ❑ Centerline Feature Intersected/Structure/Bents/Piers
- ❑ Working Line/Construction Line Call-out
- ❑ Skew and Complement at Centerline Feature Intersected (also show at substructure if different)
- ❑ Centerline Railroad Track to Centerline Railroad Track Dimension
- ❑ Longitudinal Dimensions
- ❑ Channel Bottom Dimension
- ❑ Berm Dimension
- ❑ Stockberm/Bike Path/Access Road Dimensions
- ❑ Offsets (throw on curve)
- ❑ Horizontal Clearance Between Centerline Railroad Track and Edge of Substructure
- ❑ Station Call-outs at Substructures/Structure/Feature Intersected
- ❑ Flow Arrow w/Name of Channel
- ❑ North Arrow
- ❑ Utilities
- ❑ To X (destinations)
- ❑ Test Holes Call-out
- ❑ Riprap/Gabions Call-out
- ❑ Approach Slabs Call-out
- ❑ Section Symbols
- ❑ Line Styles/Patterning
- ❑ Existing Structure Call-out

Elevation

- ❑ Detail to Scale/Projected from Plan
- ❑ Grade/Vertical Curvature
- ❑ Detail Skewed w/Superelevation (if information is available)
- ❑ Railroad/Cross Road
- ❑ Finished Grade Elevations
- ❑ Top of Riprap/Gabions Call-outs w/Elevation
- ❑ Ordinary High Water Call-out w/Elevations
- ❑ Design Q/Review Q High Water Call-out w/Elevations

Elevation (Cont'd)

- ❑ Bottom of Channel Elevation
- ❑ Design Scour Elevation and Call-out
- ❑ Footing/Pile Call-out/Number Required
- ❑ Embankment Protection Call-out
- ❑ Existing Ground Line Call-out w/Symbols
- ❑ Channel Material to Remain in Place or Removed
- ❑ Elevation Scale
- ❑ Pedestrian Safety Railing
- ❑ Splashboard w/Length (railroad)
- ❑ Light Standards
- ❑ Deck Drainage System
- ❑ Vertical Clearances (cross road/stockberm/railroad)
- ❑ Line Styles/Patterning
- ❑ Span Subtitles w/Length
- ❑ Substructure Subtitles
- ❑ Superstructure Type (under title)

Section A-A

- ❑ Centerline Bridge Roadway
- ❑ Clear Roadway Width
- ❑ Sidewalk Width
- ❑ Girder Spacing
- ❑ Cross Slope(s) in Percent
- ❑ Overlay (precast concrete bridge)
- ❑ Railing
- ❑ Pedestrian Safety Railing
- ❑ Splashboard w/Vertical Dimensions (railroad)
- ❑ Line Styles/Patterning

Typical Roadway Section

- ❑ Centerline Survey/Construction
- ❑ Horizontal Dimensions
- ❑ Slope(s)
- ❑ Profile Grade/Superelevation Point
- ❑ Wearing Course/Chip Seal Call-out
- ❑ Pavement Call-out w/Thickness
- ❑ Base Material Call-out w/Thickness
- ❑ Line Styles/Patterning

Horizontal Curve Data

- ❑ Centerline Survey/Construction
- ❑ Stationing
- ❑ Bearings
- ❑ Structure Located on Curve
- ❑ Curve Information

Grade Data

- ❑ Grade(s)
- ❑ Structure Located on Grade Line
- ❑ Curve Information

Notes

- ❑ Finish Grade Elevations
- ❑ Berm Slopes
- ❑ Replacement Structure w/Structure Numbers

Preliminary Culvert Layout Checklist

Location Plan

- ❑ Detail to Scale
- ❑ Centerline Survey w/Stationing and Bearing
- ❑ Centerline Culvert
- ❑ Skew and Complement at Centerline Survey
- ❑ Longitudinal Dimensions
- ❑ Station Call-out at Centerline Culvert
- ❑ Flow Arrow w/Name of Channel
- ❑ North Arrow
- ❑ Utilities
- ❑ Right-of-Way Lines Call-out
- ❑ To X (destinations)
- ❑ Riprap/Gabions Call-out
- ❑ Culvert Subexcavation Call-out
- ❑ Existing Structure Call-out
- ❑ Section Symbols
- ❑ Line Styles/Patterning

Longitudinal Section

- ❑ Horizontal Dimensions (precast culvert)
- ❑ Slope
- ❑ Elevations (not needed for culvert extensions)
- ❑ Flow Line Call-out
- ❑ Precast Parapet/Cutoff Wall Call-outs
- ❑ Railing
- ❑ Fill Slope w/Dirt Symbol
- ❑ Patterning

Section A-A

- ❑ Barrel Opening Dimensions
- ❑ Optional Construction Joints Call-out (precast culvert)
- ❑ Patterning

Typical Roadway Section

- ❑ Centerline Survey/Construction
- ❑ Horizontal Dimensions
- ❑ Clear Zone Dimensions
- ❑ Slope(s)

Typical Roadway Section (cont'd)

- ❑ Profile Grade/Superelevation Point
- ❑ Wearing Course/Chip Seal Call-out
- ❑ Pavement Call-out w/Thickness
- ❑ Base Material Call-out w/Thickness
- ❑ Line Styles/Patterning

Horizontal Curve Data

- ❑ Centerline Survey/Construction
- ❑ Stationing
- ❑ Bearings
- ❑ Structure Located on Curve
- ❑ Curve Information

Grade Data (when top slab is at grade)

- ❑ Grade(s)
- ❑ Structure Located on Grade Line
- ❑ Curve Information

Notes

- ❑ Replacement Structure w/Structure Numbers

Railroad Site Layout Checklist

Site Layout

- ❑ Detail to Scale
- ❑ Centerline Survey w/Stationing and Bearing
- ❑ Centerline Bridge Roadway (may be concurrent w/Centerline Survey)
- ❑ Centerline Tracks/Structure/Bents/Piers
- ❑ Working Line/Construction Line Call-out
- ❑ Skew and Complement
- ❑ Centerline Track to Centerline Track Dimension
- ❑ Horizontal Clearance Between Centerline Track and Edge of Substructure
- ❑ Location of Minimum Vertical Clearance Call-out
- ❑ Station/Milepost Call-outs at Bents/Piers/Feature Intersected
  (include station call-out at abutment if railroad is under end span)
- ❑ Ahead Milepost Call-out
- ❑ North Arrow
- ❑ Flow Arrow w/Name of Channel
- ❑ Utilities
- ❑ Right-of-Way Lines Call-out
- ❑ Test Holes Call-out
- ❑ Existing Substructure Call-out
- ❑ Line Styles/Patterning

Notes

- ❑ Minimum Vertical Clearance (if not given in layout)
- ❑ US DOT Number (if not given in layout)

Track Profile Checklist

Elevation

- ❑ Detail to Scale
- ❑ Centerline Survey/Median/Bridge Roadway
- ❑ Vertical Clearance
- ❑ Station/Milepost Call-out
- ❑ Top of Rail Call-out
- ❑ Ahead Station/Milepost Call-out
- ❑ Safety Fence/Splashboard Call-out
- ❑ Scales