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ENGINEERING SUPPORT PROGRAM

WOLT0009-001

Sagai Crossing Bridge Construction Project

Khost, Afghanistan

Design Analysis – Final Design Submittal

October 8, 2011

This publication was produced for review by the United States Agency for International Development. It was prepared by Tetra Tech, Inc.

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Design Analysis

Introduction: The Design Analysis provides documentation of the basis for the - design on the project. It is intended to describe the project requirements, identify governing codes and criteria being utilized, explain proposed design solutions and document other situations which affect the design. Engineering calculations, initialed and dated by the design engineer, are also included where appropriate.

The Design Analysis is organized by content and technical design discipline as follows:

Section 1 - Hydraulics

Section 2 - Geotechnical

Section 3 - Civil

Section 4 - Structural

Section 5 - Bill of Quantities

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Section 1
Hydraulics

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Design Analysis

Discipline:	Hydraulics	**Date:**	September 29, 2011

Design Submittal: Final Design Submittal
Site Location: Khost Province, Afghanistan
Prepared By: Tetra Tech

I. General Summary:

The existing Sagai wadi, located in the province of Khost Afghanistan, floods during periods of the spring ice melting and the summer rainy season. During these periods, the existing concrete roadway across the wadi overtops and the 315m crossing is impassable. In addition, due to the strong flows and the scour-susceptible soils at the site, the concrete road is severely deteriorated.

The objective is to perform final design for a new bridge crossing adjacent to the concrete roadway. The proposed bridge superstructure and substructure is constructed out of reinforced concrete. Approach roadway work will be required to transition from the existing roadway to the bridge. Riprap and guide banks will be used to protect the substructure and approaches, as required for scour protection.

II. Detailed Analysis:

Guide banks were designed to protect the north abutment of the proposed bridge, which encroaches 100 meters into the wadi. The purpose of constructing a guide bank is to reduce the scour at the abutment by lessening the turbulence at the abutment and to move the scour away from the abutments. The south bank will be graded at an approach angle of 3:1 to provide a smooth transition. At the north abutment, guide banks will be provided. The guide bank will begin at western side of the bridge and end at eastern side of the bridge, and will be graded at 3:1 side slope. The guide bank on the north abutment, as well as graded section in the south bank, will be armored with rock riprap.

A scour analysis was performed in order to determine the scour depth at the proposed bridge. Without the guide banks, the scour depth was determined to be 6.92 meters on the north abutment and 5.47 meters on the south abutment. With the guide banks, the scour depth at the abutments was reduced to be 3 meters at the abutments and 2 meters at the piers. Considering additional factor of safety, the bottom of abutment footings shall be 4 meters below grade and the bottom of pier footings shall be 2.5 meters below grade.

A limited hydrologic analysis was performed for the proposed bridge construction. The bridge is designed for a 100-year return interval. There is not enough data available regarding rainfall depth, rainfall distribution, soil and vegetation characteristics, and topography in the project area to perform a detailed hydrologic model to determine the design discharge. Instead, an indirect approach based on discharge per unit area was adopted.

III. Basis of Design

Additional Design Basis information is included in the attached model, analyses and calculations.

- The guide banks and the riprap design were designed based on Hydraulic Engineer Circular (HEC) No. 23, and scour analyses were based on HEC No. 11. The guide bank is designed as a quarter ellipse. At the upstream end of the proposed bridge, the length of the major axis is 70 feet and the length of the minor axis is 28 feet. At the downstream end of the bridge, guide banks will be constructed with major axis of 15 meters and a minor axis of 6 meters.

- HEC-RAS was used for the hydraulic analysis. The model is based on a 195-meter long bridge, with twelve piers spaced at 15-meters and an abutment on either side. The bridge piers are 1.5 meters thick and sharp nosed. Floating debris around the bridge piers was not included.

IV. Material Properties

- Riprap: Riprap shall be rough stone, fractured to sub angular, and have a specific gravity of at least 2.65. The D_{50} (median diameter) of the riprap shall be 0.46 m.

- Geotextile: Geotextile for use beneath rock riprap and riverbank slope protection shall be a woven polyester or polypropylene material having a weight of 372 to 407 grams per square meters. Bedding material, which consists of well-graded sand particles, can be used as an alternative to geotextile.

V. References

- U.S. Department of Transportation, Hydraulic Engineering Circular No. 23, Bridge Scour and Stream Instability Countermeasures: Experience, Selection, and Design Guidance – Third Edition, (2009)

- U.S. Department of Transportation, Hydraulic Engineering Circular No. 11, Design of Riprap Revetment, (1989)

- Favre Raphy, Kamal Golam Manowar *Watershed Atlas of Afghanistan* (2004)

- United States Geological Society (USGS), *Stream flow Characteristics of Stream in Southern Afghanistan* (2010)

IV. List of Attachments:

- Hydrologic Analysis

- Scour Analysis

- Design of Guide Banks and Riprap Revetment

- HEC-RAS model

Hydrologic Analysis

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Watershed Delineation
Watershed was delineated based on the topographic map available from the ArcGIS server library. The watershed area was found to be 1511 square kilometers.

Stream gage data
Stream flow data and probability of occurrence of annual high discharges for stream gages in the vicinity of the project area were available from USGS website (http://afghanistan.cr.usgs.gov/water.php). These stream gages and the project locations are in the same major watershed, Kabul watershed (Indus basin).

Design Discharge
The bridge is designed for a 100-year return interval. There is not enough data available regarding rainfall depth, rainfall distribution, soil and vegetation characteristics, and topography in the project area to perform a detailed hydrologic model to determine the design discharge. Instead, an indirect approach based on discharge per unit area was adopted.

Discharges per unit area for the stream gages in the vicinity were calculated, and are shown in Table 1. A discharge of 0.45 m^3/km^2 was selected for the project area and the 100-year design discharge at the proposed bridge was calculated to be 680 m^3/s.

Table 1. Streamflow Discharges

Gage Station	Location	Drainage Area	Peak Discharge	Discharge per sq. km
		(sq. km.)	(m^3)	(m^3/km^2)
Spera River near Spera, Afghanistan	17 Miles upstream	755	427	0.57
Matun River at Matun, Afghanistan	5.1 miles north	340	149	0.44
Shumal River at Tora Tigha, Afghanistan	17 Miles downstream	4220	660	0.16

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Scour Analysis

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Design Discharge
The watershed area for the proposed bridge is approximately 1511 square kilometers. The 100-year design discharge was calculated to be 680 m^3/s. See the "Hydrological Analysis" for additional discussion on hydrology.

Sediment Gradation
Twelve test pits and twelve boreholes were dug in the project area and gradation analyses were performed for samples obtained at every meter increment for each test pit and borehole. These gradation analyses were reviewed and a representative sediment sample was selected.

The gradation analysis for the representative sample was then corrected to consider for larger sediments (4-6 inch) that were not included during the sieve analysis. Based on the field photographs, it was assumed that 5 percent by weight of the total sediment is comprised of 4-6 inch diameter gravels. The corrected D_{50} of the sediment in the riverbed was calculated as 12 mm and the D_{95} was calculated as 100 mm. The corrected gradation curve is presented in Figure 1.

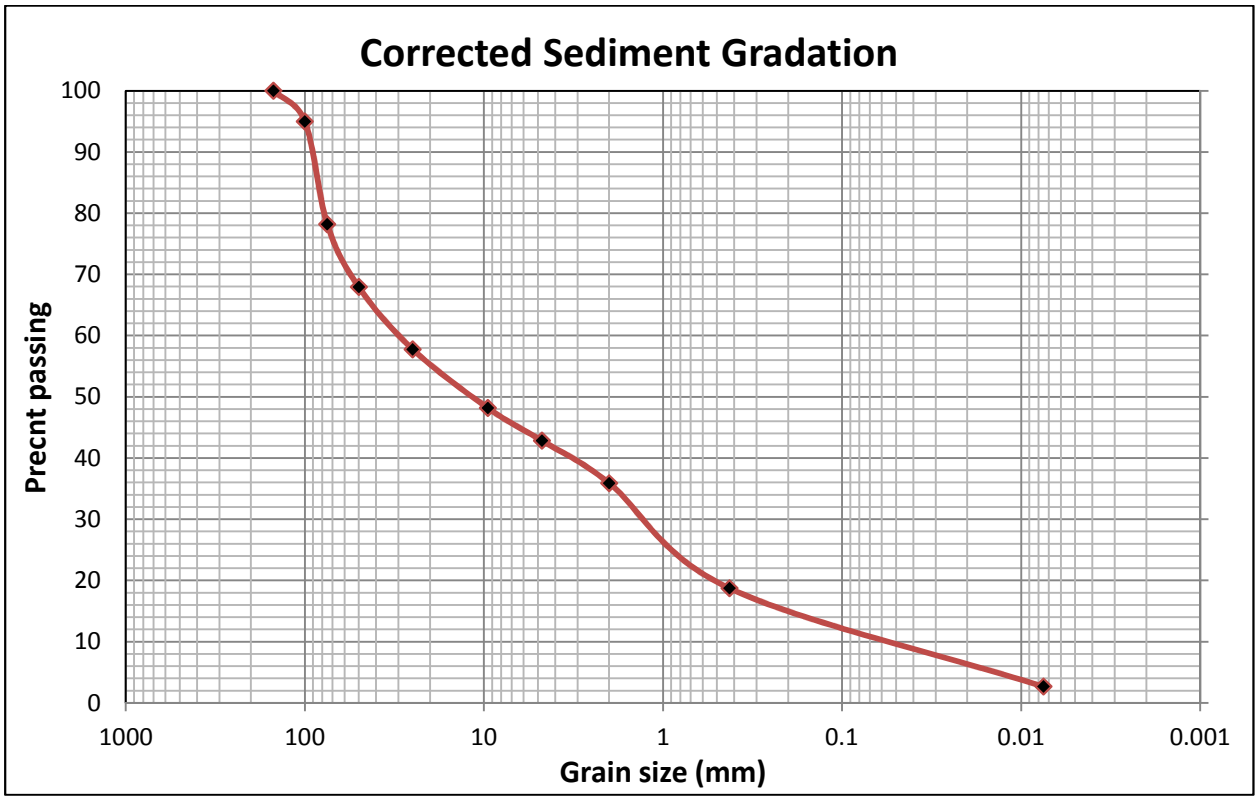

Figure 1. Corrected Sediment Gradation

Hydraulic Parameters
A HEC-RAS model was developed to obtain the flow characteristics in the channel. Field survey was performed and contours with interval of 0.25 meters were generated. Cross-sections across the river were obtained from the topographic map thus produced. The locations of the cross-sections are shown in Figure 2. A Manning's coefficient of 0.03 was selected for channel and overbank roughness because the riverbed was not vegetated and maximum gravel size in the bed was 4-6 inches in diameter. Normal depth with slope of 3 percent was selected for downstream boundary condition. This is consistent with the bed slope near the downstream boundary.

The 195-meter long bridge was modeled in the HEC-RAS program. The bridge had twelve piers with spacing at 15-meters and an abutment on either side. The bridge piers are 1.5 meters thick and sharp nosed. Floating debris around the bridge piers was ignored because human settlement upstream of the project area is sparse and vegetation upstream is mountain brush. These inferences are based on observations of aerial images obtained from Google Earth.

Bridge Scour Analysis

Scour in a bridge can be general/uniform scour (contraction scour), or localized scour (around piers or abutments). For this study, sufficient information was not available to assess any current channel down cutting in the vicinity of the proposed bridge, so long-term general scour was not considered.

The scour analysis was performed using the HEC-RAS program. The total scour is the sum of uniform scour and localized scour. Contraction scour can either be clear water scour or live bed scour. For this analysis, clear-water calculations were used because they typically yield results that are more conservative. Clear water scour takes place when velocity and shear stress in the upstream channel are low and there is no movement of bed load from the upstream sections into the bridge area. Sediment from the upstream sections travels around bridge piers and abutments as suspended load.

Clear-water contraction scour is calculated in the HEC-RAS program using the scour equation published in Hydrologic Engineering Circular (HEC) No. 18 publication, which is based on Laursen's research (1963). The local scour analysis around the piers was performed using the Colorado State University (CSU) equation programmed in the HEC-RAS model and local scour around the abutment was calculated using HIRE equation.

An initial abutment scour analysis was performed was performed assuming a spill through type abutment without riprap armoring. This type of abutment provides streamlines the water around the abutment and thus reduces the vortex formation around the piers. Vertical abutments with no wing walls tend to generate more vortices and will result in larger scour depths (up to 80% larger) than the scour depth associated with spill-through abutments. For constructability, the proposed abutment is a vertical wall abutment; however, the abutment is protected guide banks with a riprap face (design discussed in following sections). The guide banks streamline the flow and reduce vortex formation at the bridge abutments. The abutments are therefore not susceptible to severe erosion.

Guide banks on the north abutment, upstream and downstream of the bridge are incorporated in the final design. The abutment scour analysis incorporated in the HEC-RAS program does not consider the water streamlining effects resulting from the guide banks. A separate analysis was performed and the analysis is discussed in the "Design of Guide Banks and Riprap Revetment" memorandum included along with this report. The results and discussions section to follow includes results from the case, where the north abutment encroaches the channel but the streamlining effects from the guide banks are not considered.

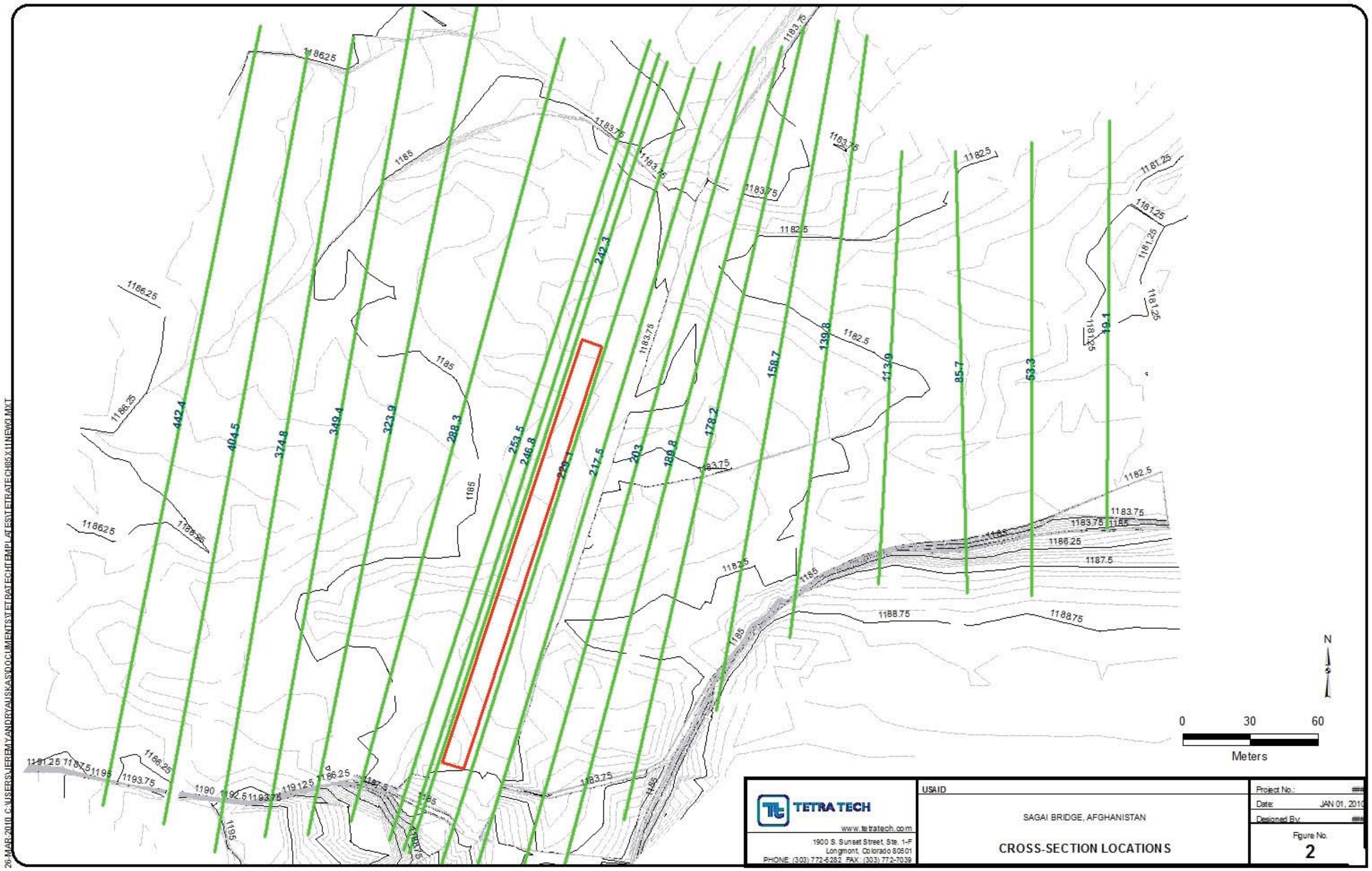

Figure 2. Bridge Location and HEC-RAS Cross-section

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Results and Discussions

The contraction scour was calculated to be 1.06 meters. The local scour at the piers was calculated as 1.0 meters. Thus, the total scour depth at the piers was 2.06 meters.

The local scour at the north abutment was 5.86 meters and at the south abutment was 4.41 meters. The total scour at the north abutment, which equals to the local scour plus the contraction scour, was 6.92 meters. The total scour at the south abutment was 5.47 meters.

The scour depths are relative to the existing ground elevations. The elevation of maximum scour at the left abutment was 1177.4 meters and at the right embankment was 1179.3 meters. The elevation of maximum scour at bridge piers was 1182.4 meters. The scour depth at the left abutment is deeper than the right abutment because the left embankment encroaches 100 meters into the river. The total scour in the channel is illustrated in Figure 3.

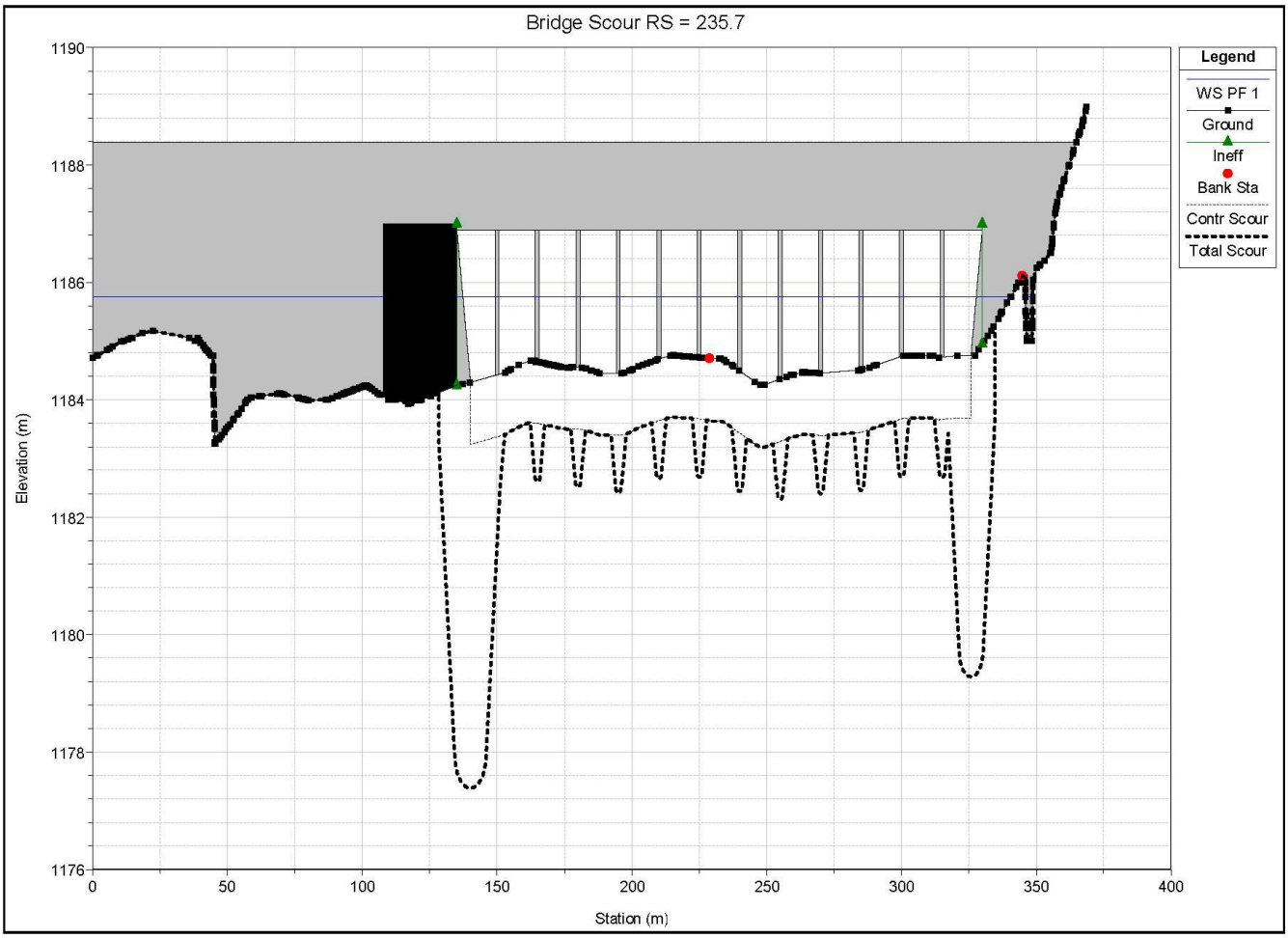

Figure 3. Scour Analysis at the Proposed Sagai Bridge

Scour depths at bridge abutments can be reduced by providing guide banks and armoring the abutments with riprap. Guide banks help streamline the water under the bridge, facilitate the water to flow into a straight channel and reduce vortex formations. The scour depth at the bridge abutments is calculated 3.0 meters with the provision of guide bank. Calculation of

scour depth is detailed in a separate section, “Design of Guide Banks and Riprap Revetments.”

Considering the potential migration of channel thalweg and long-term channel degradation and riprap armoring, which are not accounted for in the calculations, it is recommended that both of the abutments should be constructed to 4.0 meters below the existing ground. The recommended pier depth is 2.5 meters below the existing grade.

Design of Guide Banks and Riprap Revetments

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Guide Banks Design

The north abutment of the proposed bridge over Sagai Wadi is designed to encroach 100 meters into the river. The purpose of constructing a guide bank is to reduce the scour at the abutment by lessening the turbulence at the abutment and to move the scour away from the abutments. The south bank will be graded at an approach angle of 3:1 to provide smooth transition. At the north abutment, guide banks will be provided upstream and downstream of the bridge. The guide bank will begin at western side of the bridge and end at eastern side of the bridge, and will be graded at 3:1 side slope. The guide bank on the north abutment, as well as graded section in the south bank, will be armored with rock riprap.

The guide bank was designed based on procedures described in Hydraulic Engineer Circular (HEC) No. 23. The hydraulic parameters such as flow depths, velocities and discharges at left overbank, right over bank and the main channel were obtained from the HEC-RAS model, and these values are shown in Table 2.

The guide bank is designed as a quarter ellipses, with the calculated major and minor axes presented in the Table 2. A schematic figure of the guide banks is shown in Figure 4. For the proposed bridge, the length of the major axis is 70 meters and the length of the minor axis is 28 meters. At the downstream end of the bridge, guide banks will be constructed with major axis of 15 meters and a minor axis of 6 meters.

Table 2. Design of guide bank

Description	Symbol	Units	
Total discharge in the stream	Q	m^3/s	680
Floodplain discharge intercepted by the embankment	$Q_{f\ left}$	m^3/s	329.25
Main channel discharge	$Q_{channel}$	m^3/s	350.75
Discharge in the 30 meter of stream adjacent of the abutment	Q_A	m^3/s	104.85
Depth of flow adjacent to abutment	y	m	1.5
Characteristic average velocity in contracted section	$V_{channel}$	m/s	2.33
Specific gravity of rock riprap	Ss		2.4
Acceleration due to gravity	g	m/s^2	9.81
Coefficient, 0.89 for spill-through abutment and 1.02 for vertical wall abutment	K		0.89
Average velocity through the bridge opening	Vn_2	m/s	2.33
Guide bank discharge ratio	$Q_{f\ left}/Q_A$		3.14
Projected length of the guide bank (major axis)	Ls	m	**70**
Length of minor axis	0.4Ls	m	**28**

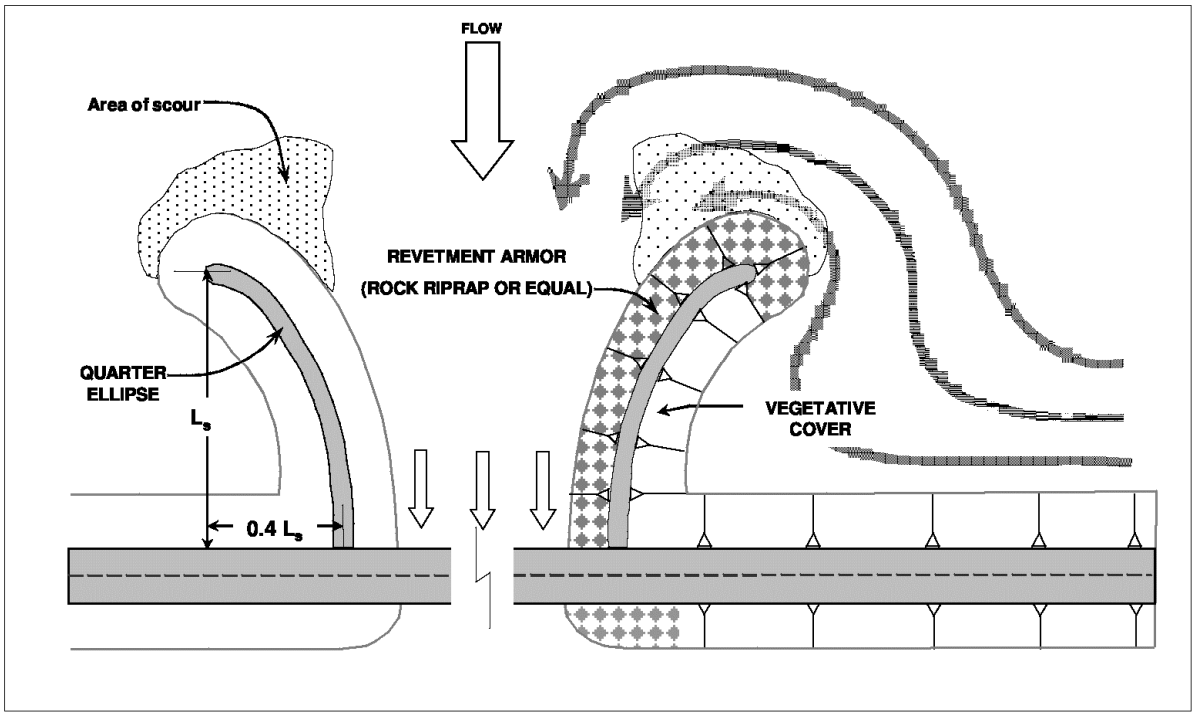

Figure 4. Typical guide bank
(Source: Hydrologic Engineering Circular No 23, 2009)

Depth of Scour:

The depth of scour is calculated to determine the toe depth for the riprap armor. Guide banks help streamline the water under the bridge, facilitate the water to flow into a straight channel and reduce vortex formations. Therefore, scour depth equations applicable for bank protection in straight channels or channels with mild bend was used. This equation (Equation 5 in HEC No. 11) is in custom units.

$$d_s = 6.5\ D_{50}^{-0.11}$$

Where
d_s = estimated probable maximum depth of scour in ft
D_{50} = median diameter of the bed material in ft

For D_{50} of 12 mm, the total scour depth is 2.83 meters. The total scour depth is thus rounded to 3.0 meters.

Riprap Design for Bridge Abutment
HEC No. 11 was used to determine the size of rock riprap for bridge abutments. The riprap design relationship is based on the tractive force theory and is in English units. The equation is described below.

$$D_{50} = \frac{0.001 * V_a^3}{(D_{avg}^{0.5} * K_1^{1.5})}\ C_c$$

Where

D_{50} = median stone diameter, ft
V_a = average velocity in the main channel, ft/s
D_{avg} = the average floe depth in the main channel
C_c = correction factor
K_1 is defined as

$$K_1 = [1 - \frac{sin^2\theta}{sin^2\phi}]^{0.5}$$

Where
θ = bank angle with horizontal
ϕ = the riprap angle of repose

$C_c = C_{sg} * C_{sf}$

Where
C_{sg} = coefficient of correction for specific gravity of rock
C_{sf} = coefficient of correction for stability factor

$$C_{sg} = 2.12/(S_g - 1)^{1.5}$$

Where
S_g = specific gravity of rock riprap

$$C_{sf} = (\frac{SF}{1.2})^{1.5}$$

Where
SF = the stability factor to be applied

For the proposed bridge at the 100-year design discharge of 680 m^3/s, the following parameters were used,

	Units	
θ	degrees	18.4°
ϕ	degrees	42°
K_1		0.69

S_g		2.5
C_{sg}		1.2
SF		1.4
C_{sf}		1.26
V_{avg}	m/s (ft/s)	3.38 (11.1)
D_{avg}	m (ft)	1.5 (4.9)
D_{50}	m (ft)	0.46 (1.5)

For design purpose, **D_{50} = 0.46 m**.

Other Considerations for Riprap Revetments at Bridge Abutments
The length of the apron is determined as twice the depth of the water in channel. The depth of water at the bridge abutment is 1.85 meters; thus, width of the apron is 3.7 meters. The crest of the guide bank will be a minimum of 0.6 meters above the design water level. The guide banks will be constructed at 3:1 slopes. A typical section of the rock riprap along the abutment is shown in Figure 5.

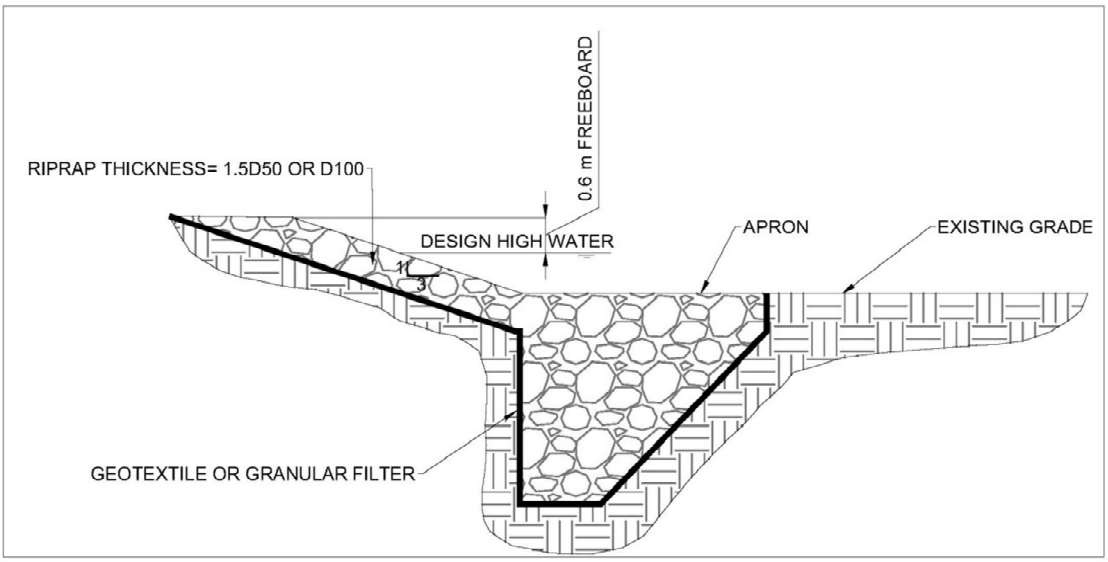

Figure 5. Typical Cross-section of riprap around bridge abutment

Riprap Revetment for Bridge Piers
The size of the riprap for bridge riveting piers was designed based on HEC-23 document using the following equation,

$$D_{50} = \frac{0.692 * (V_{des})^2}{(S_g - 1) * 2g}$$

Where
D_{50} = particle size diameter for which 50% is finer by weight, (m)
V_{des} = design velocity around bridge piers (m/s)
S_g = specific gravity of rock riprap

g = acceleration due to gravity (m/s^2)

$V_{des} = K_1 * K_2 * V_{avg}$

Where
K_1= shape factor equal to 1.5 for square face piers
K_2 = velocity adjustment factor for location of the channel

For the proposed bridge at the 100-year design discharge of 680 m^3/s, the following parameters were used,

	Units	
K_1		1.7
K_2		1
V_{avg}	m/s	2.33
V_{des}	m/s	4.36
S_g		2.5
g	m/s^2	9.81
D_{50}	m	0.41

For design purpose, **D_{50} = 0.46m.**

Other Considerations for Riprap Revetments at Bridge Piers

The riprap will be extended 2 times the pier width in all directions. The riprap shall be placed in a pre-excavated hole around the pier so that the top of the riprap layer is level with the ambient channel bed elevations. The rip layer should have a minimum thickness of three times the D_{50} size of rock riprap. The filter should not extend fully beneath the riprap but should be terminated 2/3 of the distance from the pier to the edge of the riprap.

A layout diagram of riprap around the pier is shown in Figure 6.

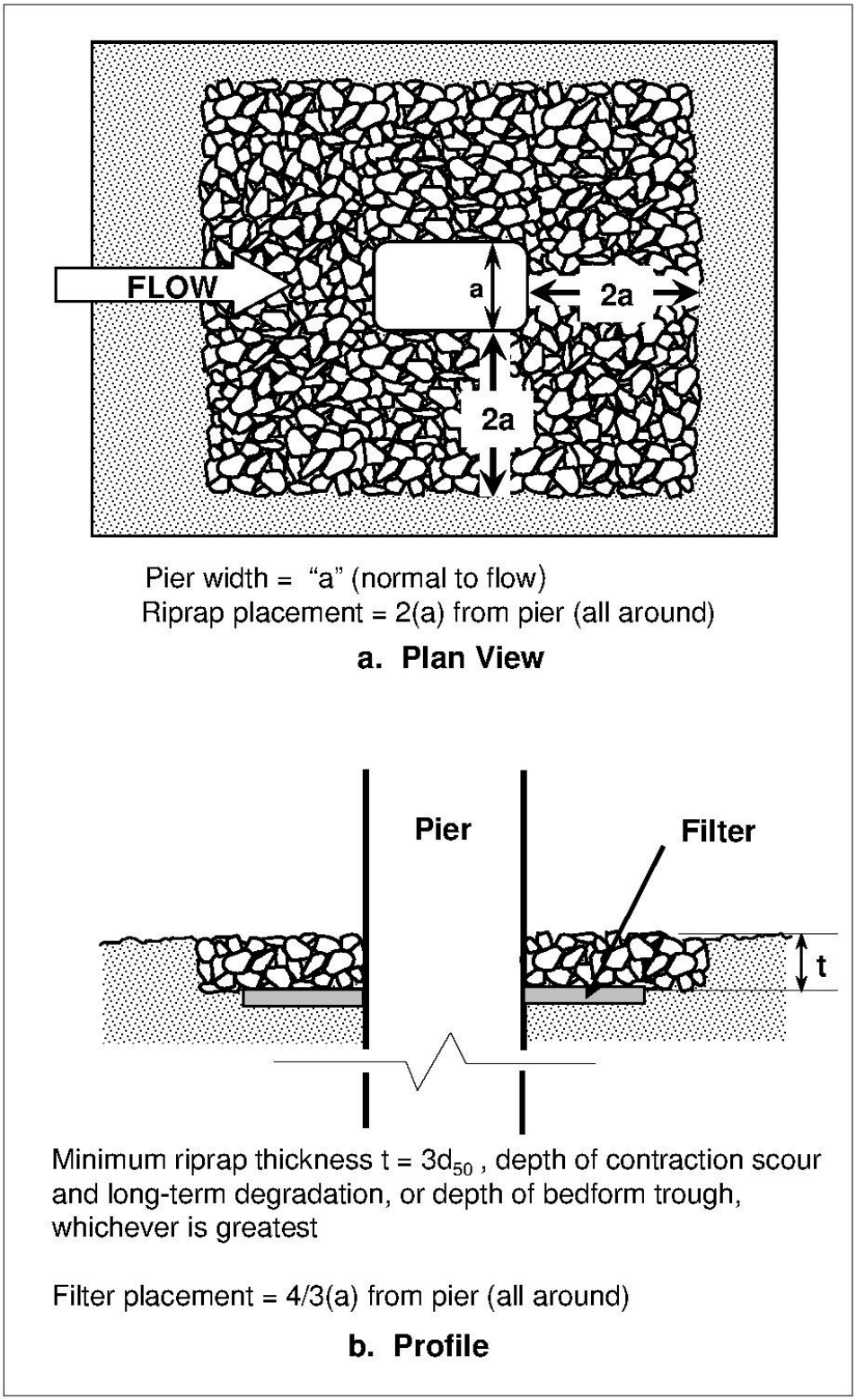

Figure 6. Riprap layout diagram for pier scour protection
(Source: Hydrologic Engineering Circular No 23, 2009)

HEC-RAS Model

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ScourAnalysis.rep

HEC-RAS Version 4.1.0 Jan 2010
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X       X   X     X  X    X
X     X  X        X            X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X            X  X     X    X        X
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X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
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PROJECT DATA
Project Title: Scour Analysis
Project File : ScourAnalysis.prj
Run Date and Time: 9/23/2011 1:22:47 PM

Project in SI units

Project Description:
Scour Analysis for the proposed bridge at Sagai wadi
Design storm - 100 year

PLAN DATA

Plan Title: 100yr 100m encroachment updated
Plan File : p:\01304\133-01304-10001\Khowst\Supporting Docs\Scour Analysis\HEC-RAS final\ScourAnalysis.p07

Geometry Title: With bridge-100m encroachment updated
Geometry File : p:\01304\133-01304-10001\Khowst\Supporting Docs\Scour Analysis\HEC-RAS final\ScourAnalysis.g06

Flow Title : 100-year discharge
Flow File : p:\01304\133-01304-10001\Khowst\Supporting Docs\Scour Analysis\HEC-RAS final\ScourAnalysis.f02

Plan Summary Information:

Number of:	Cross Sections	= 20	Multiple Openings	=	0
	Culverts	= 0	Inline Structures	=	0
	Bridges	= 1	Lateral Structures	=	0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only

Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: 100-year discharge
Flow File : p:\01304\133-01304-10001\Khowst\Supporting Docs\Scour Analysis\HEC-RAS final\ScourAnalysis.f02

Flow Data (m3/s)

River	Reach	RS	PF 1
Khowst	Reach1	442.4	680

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Khowst	Reach1	PF 1	Critical	Normal S = 0.03

GEOMETRY DATA

Geometry Title: With bridge-100m encroachment updated
Geometry File : p:\01304\133-01304-10001\Khowst\Supporting Docs\Scour Analysis\HEC-RAS final\ScourAnalysis.g06

CROSS SECTION

RIVER: Khowst
REACH: Reach1 RS: 442.4

INPUT
Description:
Station Elevation Data num= 200

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1186.63	3.19	1186.58	8.22	1186.5	11.19	1186.5	11.6	1186.25
12.47	1186	19.96	1186	20.75	1185.99	23.86	1185.97	25.98	1185.97
26.47	1185.96	28.59	1185.95	29.56	1185.95	30.46	1185.94	33.01	1185.94
34.44	1185.93	36.33	1185.93	37.73	1185.92	39.46	1185.92	40.62	1185.91
42.98	1185.91	43.2	1185.9	43.94	1185.9	46.28	1185.83	52.69	1185.89
62.01	1185.95	64.22	1185.95	65.5	1185.96	71.08	1185.97	84.23	1185.97
84.45	1185.96	95.61	1185.96	106.17	1185.95	115.45	1185.93	120.94	1185.96
126.16	1185.92	126.65	1185.93	128.56	1185.96	132.5	1185.96	135.28	1185.95
137.39	1185.95	139.02	1185.94	141.05	1185.94	142.55	1185.93	144.7	1185.93
146.21	1185.9	146.81	1185.88	147.69	1185.88	148.39	1185.85	148.93	1185.85
149.73	1185.81	149.95	1185.81	150.68	1185.87	150.92	1185.8	151.76	1185.57
151.86	1185.55	153.42	1185.69	154.13	1185.67	155.02	1185.66	155.55	1185.65
155.79	1185.66	164.34	1185.69	164.73	1185.69	165.07	1185.7	165.43	1185.7
165.96	1185.71	166.25	1185.71	166.78	1185.72	167.62	1185.72	168.88	1185.74
169.57	1185.74	169.9	1185.75	170.9	1185.75	171.47	1185.76	171.97	1185.76

177.51	1185.77	179.87	1185.78	183.5	1185.78	184.81	1185.79	186.59	1185.79
188.73	1185.81	195.78	1185.97	196.89	1185.98	197.79	1186	197.99	1186
207.36	1186.18	208.67	1186.2	209.13	1186.21	209.63	1186.21	210.59	1186.22
212.18	1186.24	213.46	1186.26	223.38	1186.28	224.5	1186.25	225.91	1186.21
226.45	1186.2	227.57	1186.17	230.77	1186.08	232.66	1186.03	233.18	1186.02
234	1186	234.34	1186	235.51	1185.98	236.48	1185.96	237.37	1185.95
238.11	1185.94	238.69	1185.93	241.76	1185.9	242.77	1185.9	243.19	1185.89
243.58	1185.89	246.99	1185.86	247.58	1185.85	252.25	1185.78	252.34	1185.78
254.18	1185.75	264.61	1185.75	265.53	1185.72	266.02	1185.71	267.74	1185.66
269.15	1185.61	269.71	1185.6	271.32	1185.55	273.15	1185.5	273.34	1185.5
274.23	1185.47	275.15	1185.45	275.95	1185.44	286.17	1185.47	287.05	1185.49
287.61	1185.5	291.23	1185.5	292.76	1185.48	292.88	1185.47	294.39	1185.45
294.59	1185.45	295.84	1185.43	299.28	1185.48	299.78	1185.5	301.18	1185.58
302.56	1185.66	303.44	1185.7	304.26	1185.75	305.44	1185.77	310.71	1185.87
316.67	1186	319.51	1186.05	319.77	1186.06	319.93	1186.06	322.65	1186.11
329.84	1186.22	330.1	1186.21	337.29	1186.42	337.92	1186.44	338.17	1186.44
338.96	1186.46	339.79	1186.47	340.35	1186.5	340.37	1187.01	340.39	1187.25
340.39	1187.39	340.41	1187.75	340.42	1187.77	340.44	1188.25	340.46	1188.5
340.46	1188.66	340.48	1188.86	340.48	1189	340.5	1189.25	340.53	1189.5
340.53	1189.35	340.54	1189.01	340.56	1189.75	340.6	1190.04	340.64	1190.25
340.67	1190.5	340.7	1190.66	340.75	1191	340.83	1191.5	340.87	1191.71
340.87	1191.75	340.92	1192.05	341.03	1192.75	341.07	1192.95	341.07	1193
341.12	1193.27	341.16	1193.58	341.21	1193.85	341.29	1194.4	341.35	1194.75
341.38	1195	341.81	1195.15	342.11	1195.25	343.87	1195.25	345.29	1195.3
346.21	1195.3	346.86	1195.31	347.65	1195.32	348.09	1195.32	352.02	1195.34

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	223.38	.03	340.39	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
223.38	340.39	38.39	37.93	36.85	.1	.3

CROSS SECTION

RIVER: Khowst
REACH: Reach1 RS: 404.5

INPUT
Description:
Station Elevation Data num= 357

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1186.33	2.19	1186.3	2.99	1186.27	3.47	1186.25	3.85	1186.12
4.24	1186	4.72	1185.82	4.74	1185.82	4.76	1185.82	4.87	1185.78
4.92	1185.79	4.95	1185.78	5.05	1185.8	5.07	1185.79	5.22	1185.82
5.29	1185.81	7.66	1185.76	15.34	1185.78	15.92	1185.78	16.49	1185.77
16.96	1185.77	17.51	1185.77	17.96	1185.77	18.6	1185.76	19.41	1185.75
19.87	1185.75	20.39	1185.75	23.06	1185.73	23.12	1185.73	23.18	1185.73
24.24	1185.72	24.3	1185.72	25.46	1185.72	25.5	1185.72	26.64	1185.71
26.68	1185.71	26.75	1185.71	27.78	1185.71	27.85	1185.71	30.82	1185.7
30.85	1185.7	31.02	1185.7	31.09	1185.7	34.5	1185.67	34.71	1185.67
34.94	1185.67	35.22	1185.67	39.67	1185.71	41.03	1185.71	41.33	1185.71
41.45	1185.72	43.01	1185.72	44.74	1185.73	45.28	1185.73	46.96	1185.74
48.65	1185.74	48.7	1185.74	50.24	1185.75	50.25	1185.75	50.99	1185.75
51.51	1185.75	51.93	1185.75	56.77	1185.73	56.9	1185.73	57.04	1185.73
57.3	1185.73	58.03	1185.72	58.2	1185.72	59.2	1185.72	60.35	1185.71
60.54	1185.71	60.68	1185.71	61.9	1185.71	61.96	1185.71	63.14	1185.7
63.19	1185.7	68.41	1185.72	68.45	1185.72	69.92	1185.75	69.93	1185.75
70.04	1185.75	71.84	1185.76	73.61	1185.77	82.68	1185.88	95.72	1185.83
96.04	1185.83	96.08	1185.83	96.13	1185.83	96.19	1185.83	96.25	1185.83
96.28	1185.82	96.32	1185.82	96.39	1185.82	96.49	1185.82	96.64	1185.82
96.83	1185.82	97.05	1185.82	97.59	1185.81	99.39	1185.78	101.98	1185.75

103.03	1185.73	103.12	1185.73	104.7	1185.71	104.94	1185.7	105.22	1185.7
106.73	1185.67	107.33	1185.68	108.54	1185.66	109.51	1185.62	110.4	1185.61
111.59	1185.59	112.15	1185.58	112.5	1185.57	114.24	1185.54	114.47	1185.54
114.63	1185.53	114.81	1185.53	116.42	1185.5	116.66	1185.47	116.8	1185.46
117.02	1185.45	118.29	1185.36	118.98	1185.34	119.69	1185.33	120.21	1185.3
120.7	1185.29	120.95	1185.29	121.04	1185.29	121.28	1185.28	121.3	1185.28
121.44	1185.27	121.46	1185.28	121.54	1185.27	121.72	1185.27	122.67	1185.26
122.88	1185.26	135.83	1185.39	142.8	1185.43	143.01	1185.43	143.4	1185.44
143.94	1185.44	144.62	1185.44	145.23	1185.45	146.01	1185.45	146.78	1185.46
147.3	1185.46	147.85	1185.47	151.84	1185.49	152.29	1185.49	153	1185.5
153.55	1185.5	153.88	1185.5	153.94	1185.5	154.78	1185.5	154.95	1185.5
159.18	1185.53	160.36	1185.54	161.56	1185.54	163.13	1185.55	164.15	1185.56
164.78	1185.56	165.06	1185.56	169.1	1185.61	171.68	1185.66	172	1185.66
172.47	1185.67	173.14	1185.68	174.07	1185.7	175.32	1185.72	176.82	1185.75
176.98	1185.75	178.23	1185.77	179.27	1185.79	180.33	1185.81	181.12	1185.83
181.66	1185.84	182.02	1185.84	187.03	1185.92	187.3	1185.93	187.86	1185.94
188.9	1185.95	190.9	1185.98	192.24	1186	193.02	1186.01	194.31	1186.03
195.06	1186.04	195.51	1186.05	195.99	1186.05	196.39	1186.06	200.34	1186.06
200.64	1186.05	200.82	1186.05	200.91	1186.05	200.95	1186.05	200.98	1186.05
201.07	1186.05	201.23	1186.05	209.49	1186.07	209.78	1186.07	210.25	1186.07
210.78	1186.07	211.31	1186.07	211.79	1186.07	212.19	1186.08	212.49	1186.08
212.65	1186.08	212.81	1186.08	213.05	1186.08	213.34	1186.08	213.66	1186.08
213.97	1186.08	214.25	1186.08	214.46	1186.08	220.35	1186.12	221.37	1186.13
221.59	1186.14	222.6	1186.15	222.81	1186.15	223.6	1186.17	223.89	1186.17
224.21	1186.18	224.53	1186.18	226.32	1186.17	226.69	1186.16	226.77	1186.16
226.85	1186.16	227.28	1186.15	227.76	1186.13	228.23	1186.12	228.84	1186.09
229.51	1186.06	230.64	1186	230.88	1185.99	231.22	1185.97	233.4	1185.85
235.32	1185.75	236.11	1185.71	237.95	1185.61	239.06	1185.54	239.88	1185.5
240.31	1185.48	241.21	1185.43	241.53	1185.41	241.67	1185.4	250.95	1185.5
252.56	1185.5	253.72	1185.49	254.17	1185.5	254.9	1185.51	256.46	1185.53
257.28	1185.53	257.75	1185.54	258.02	1185.54	258.16	1185.54	258.3	1185.55
258.49	1185.55	258.69	1185.55	258.87	1185.55	259.78	1185.55	260.19	1185.55
260.7	1185.54	261.24	1185.54	261.63	1185.54	261.93	1185.53	262.09	1185.53
263.11	1185.53	264.99	1185.52	267.42	1185.5	271.1	1185.48	272.16	1185.47
272.52	1185.47	273.67	1185.46	273.87	1185.46	273.88	1185.46	273.9	1185.46
274.02	1185.46	274.07	1185.45	274.17	1185.45	274.34	1185.45	274.68	1185.44
275.42	1185.42	277.05	1185.39	283.41	1185.25	284.23	1185.23	287.01	1185.17
288.15	1185.15	288.71	1185.13	290.34	1185.14	290.71	1185.16	291.71	1185.21
292.61	1185.25	295.93	1185.42	297.62	1185.5	301.62	1185.7	302.66	1185.75
302.74	1185.75	302.98	1185.77	305.02	1185.83	309.23	1185.86	310.31	1185.86
310.35	1185.86	310.49	1185.86	311.56	1185.87	311.94	1185.87	312.52	1185.87
313.2	1185.87	313.93	1185.87	314.76	1185.88	317.63	1185.89	318.54	1185.89
320.73	1185.89	321.37	1185.89	323.41	1185.93	323.96	1185.95	324.82	1186
324.91	1186	326.04	1186.06	327.13	1186.11	329.41	1186.23	329.9	1186.25
330.44	1186.28	333.11	1186.44	334.06	1190.57	334.09	1190.72	334.12	1190.86
334.16	1191.01	334.19	1191.15	334.22	1191.29	334.25	1191.43	334.29	1191.57
334.32	1191.7	334.35	1191.84	334.38	1191.97	334.41	1192.1	334.44	1192.23
334.47	1192.36	334.5	1192.49	334.53	1192.62	334.56	1192.74	334.59	1192.87
334.62	1192.99	334.64	1193.12	334.67	1193.24	334.7	1193.36	334.73	1193.48
334.75	1193.59	334.78	1193.71	334.8	1193.83	334.83	1193.94	334.85	1194.06
335.45	1194.82	336.68	1195.27	337.09	1195.41	337.43	1195.54	341.75	1195.63
348.42	1195.67	348.65	1195.68						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	224.53	.03	333.11	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
224.53	333.11	24.56	29.7	32.53	.1	.3

CROSS SECTION

RIVER: Khowst
REACH: Reach1 RS: 374.8

INPUT
Description:
Station Elevation Data num= 419

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1186.25	.26	1186.25	.42	1186.25	.63	1186.25	.68	1186.25
1.66	1186.25	2.59	1186.25	2.62	1186.25	2.66	1186.25	3.39	1186.25
3.71	1186.25	3.81	1186.25	4.59	1186.25	4.74	1186.25	4.93	1186.25
5.12	1186.25	6.16	1186.25	9.36	1186.25	12.4	1186.43	12.9	1186.44
13.21	1186.45	13.72	1186.42	13.86	1186.39	14.26	1186.28	14.35	1186.25
14.83	1186.1	15.15	1186	15.49	1185.89	15.95	1185.75	16.24	1185.66
16.75	1185.5	17.23	1185.35	17.28	1185.33	17.44	1185.33	17.5	1185.33
17.88	1185.35	21.48	1185.5	21.72	1185.51	22.2	1185.53	24.25	1185.56
24.74	1185.56	25.22	1185.56	28.43	1185.55	30.57	1185.53	34.9	1185.5
35.11	1185.5	36.12	1185.49	40.13	1185.46	42.91	1185.47	44.31	1185.48
52.1	1185.45	52.6	1185.45	56.38	1185.45	57.35	1185.46	58.37	1185.46
59.09	1185.46	59.41	1185.46	59.74	1185.46	60.29	1185.46	60.94	1185.46
61.58	1185.46	62.07	1185.46	62.28	1185.46	62.39	1185.46	62.55	1185.46
62.65	1185.46	65.11	1185.45	65.51	1185.45	65.68	1185.45	66.04	1185.45
66.44	1185.45	66.89	1185.44	67.83	1185.44	68.49	1185.43	68.92	1185.43
69.84	1185.43	71.76	1185.44	72.38	1185.42	73.52	1185.42	73.67	1185.41
74.05	1185.41	78.01	1185.39	80.07	1185.41	80.55	1185.4	81.48	1185.41
82.06	1185.4	83.12	1185.41	83.76	1185.4	84.88	1185.41	85.53	1185.4
86.66	1185.41	87.28	1185.4	88.35	1185.41	88.91	1185.4	89.85	1185.41
90.29	1185.41	91.06	1185.41	91.34	1185.41	91.56	1185.42	92.05	1185.42
92.25	1185.42	92.36	1185.42	92.52	1185.43	92.77	1185.41	92.87	1185.41
93.09	1185.41	93.31	1185.41	93.45	1185.4	93.6	1185.4	93.79	1185.4
94.15	1185.39	94.62	1185.39	95.24	1185.38	95.86	1185.37	96.79	1185.35
97.4	1185.34	98.69	1185.32	99.16	1185.31	100.84	1185.28	101.04	1185.27
101.2	1185.27	102.19	1185.25	102.64	1185.16	102.81	1185.16	103.1	1185.16
103.83	1185.08	104.47	1185.09	105.14	1185.09	105.65	1185.07	106.42	1185.07
106.74	1185.06	107.49	1185.06	107.87	1185.01	108.48	1185.01	108.86	1185.01
109.22	1185.01	109.81	1185.01	110.5	1185.02	111.02	1185.06	111.9	1185.06
112.22	1185.05	113.15	1185.06	113.49	1185.05	114.37	1185.06	114.71	1185.05
115.47	1185.05	119.23	1185.04	119.69	1185.04	119.94	1185.04	120.06	1185.04
120.1	1185.04	120.14	1185.04	120.24	1185.05	120.4	1185.05	120.64	1185.05
122.88	1185.1	124.39	1185.11	124.63	1185.11	124.96	1185.11	136.22	1185.25
137.09	1185.25	137.59	1185.25	138.55	1185.25	139.05	1185.25	140.06	1185.25
142.99	1185.2	143.47	1185.2	143.99	1185.21	144.54	1185.21	145.02	1185.21
145.37	1185.22	145.78	1185.22	146.5	1185.22	147.46	1185.22	148.58	1185.22
150.39	1185.25	150.65	1185.25	152.21	1185.25	152.47	1185.25	154.06	1185.25
155.41	1185.25	155.87	1185.25	157.1	1185.25	157.65	1185.25	158.57	1185.25
159.22	1185.25	159.7	1185.25	160.31	1185.25	160.47	1185.25	162.51	1185.29
164.81	1185.34	166.08	1185.37	169.07	1185.44	171.8	1185.5	175.39	1185.57
178.16	1185.63	183.96	1185.75	184.85	1185.76	196.75	1185.85	205.59	1185.96
207.33	1185.99	207.82	1186	208.72	1186.02	211.29	1186.06	215.97	1186.1
216.32	1186.1	216.7	1186.1	217.07	1186.09	218.13	1186.08	218.68	1186.06
219.61	1186.04	221.28	1186	232.15	1185.78	233.57	1185.75	235.37	1185.7
235.49	1185.7	235.78	1185.69	237.09	1185.66	237.61	1185.64	238.2	1185.63
238.59	1185.62	239	1185.61	239.48	1185.59	240.23	1185.58	242.97	1185.5
242.98	1185.5	242.99	1185.5	243.05	1185.5	243.31	1185.49	243.85	1185.47
244.4	1185.45	244.84	1185.44	246.8	1185.37	255.55	1185.29	256.59	1185.29
257.91	1185.28	260.8	1185.27	261.1	1185.27	263.23	1185.26	264.33	1185.25
267.54	1185.22	270.9	1185.2	274.08	1185.18	277.02	1185.21	277.47	1185.21
277.85	1185.21	278.26	1185.22	278.91	1185.22	279.74	1185.22	280.64	1185.22
281.53	1185.22	282.31	1185.22	282.88	1185.22	286.32	1185.22	286.81	1185.21
287.3	1185.21	288.04	1185.2	288.87	1185.19	289.65	1185.18	289.92	1185.18
299.35	1185.2	300.14	1185.21	300.9	1185.23	302.09	1185.25	302.11	1185.25
304.76	1185.34	305.44	1185.36	307.73	1185.42	308.9	1185.46	310.37	1185.5
310.67	1185.51	311.15	1185.51	327.47	1185.72	329.04	1185.73	329.73	1185.74
331.32	1185.74	331.35	1185.74	331.39	1185.74	331.42	1185.75	331.48	1185.75

331.52	1185.75	331.53	1185.75	332.75	1185.82	332.93	1185.83	333.81	1185.88
334.09	1185.89	334.59	1185.92	335.39	1185.95	335.59	1185.96	335.76	1185.96
335.87	1185.97	336.91	1186	336.97	1186	336.98	1186	338.17	1186.04
338.35	1186.05	339.08	1186.08	339.23	1186.09	339.28	1186.18	340.3	1186.26
340.67	1186.31	341.26	1186.4	341.51	1186.42	341.94	1186.5	341.95	1186.32
341.95	1186.25	341.98	1186.45	342.01	1186.75	342.08	1186.95	342.09	1187
342.12	1187.08	342.17	1187.25	342.21	1187.37	342.25	1187.5	342.33	1187.74
342.33	1187.75	342.33	1187.77	342.41	1188	342.46	1188.16	342.48	1188.25
342.52	1188.36	342.56	1188.5	342.6	1188.68	342.62	1188.75	342.67	1188.99
342.67	1189	342.72	1189.24	342.72	1189.25	342.73	1189.31	342.77	1189.5
342.78	1189.53	342.82	1189.75	342.85	1189.92	342.87	1190	342.9	1190.18
342.92	1190.25	342.93	1190.33	342.97	1190.5	343	1190.69	343.02	1190.75
343.06	1190.95	343.07	1191	343.07	1191.05	343.11	1191.25	343.13	1191.31
343.16	1191.5	343.21	1191.73	343.21	1191.75	343.22	1191.81	343.26	1192
343.3	1192.21	343.31	1192.25	343.36	1192.5	343.36	1192.51	343.41	1192.75
343.43	1192.85	343.45	1193	343.5	1193.23	343.5	1193.25	343.51	1193.29
343.55	1193.5	343.57	1193.58	343.6	1193.75	343.62	1193.86	343.65	1194
343.67	1194.41	343.68	1194.5	343.68	1194.42	343.7	1194.25	343.7	1194.42
343.72	1194.75	343.75	1194.75	343.8	1194.75	343.92	1194.75	343.98	1194.75
344.56	1194.75	344.64	1194.75	344.66	1194.75	345.57	1194.7	345.88	1194.69
346.67	1194.65	347.27	1194.62	347.74	1194.59	348.34	1194.6	348.92	1194.51
348.96	1194.53	349.23	1194.62	349.41	1194.67	349.53	1194.71	349.64	1194.75
349.82	1194.8	349.85	1194.81	349.96	1194.84	350.03	1194.85	350.12	1194.87
350.17	1194.88	350.26	1194.89	350.31	1194.9	350.39	1194.91	350.62	1194.95
350.7	1194.97	350.91	1195	351.27	1195.06	351.47	1195.09	351.89	1195.16
352.43	1195.25	352.6	1195.28	352.81	1195.31	353.45	1195.42	353.96	1195.5
354.88	1195.5	356.87	1195.51	358.76	1195.51	360.45	1195.52	361.86	1195.52
362.94	1195.53	364.27	1195.56	364.83	1195.57	366.15	1195.56		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	211.29	.03	341.94	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
211.29	341.94	24.08	25.43	28.97	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
0	43	1187	F

CROSS SECTION

RIVER: Khowst
REACH: Reach1 RS: 349.4

INPUT
Description:
Station Elevation Data num= 366

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1186.25	.48	1186.25	.95	1186.25	1.55	1186.25	9.37	1186.19
10.65	1186.14	10.66	1186.14	10.67	1186.14	10.93	1186.13	11.93	1186.02
12.57	1186.02	13.38	1186.02	13.77	1186.01	13.97	1186.01	14.87	1186
15.07	1185.91	15.41	1185.75	15.67	1185.62	15.93	1185.5	16.1	1185.42
16.83	1185.28	16.95	1185.28	17.04	1185.28	19.83	1185.41	19.89	1185.41
20.3	1185.42	20.5	1185.42	20.9	1185.41	21.26	1185.41	22.1	1185.42
28.23	1185.42	29.56	1185.42	31	1185.41	39.32	1185.35	46.06	1185.28
51.87	1185.25	55.75	1185.21	56.3	1185.21	56.75	1185.21	57.04	1185.21
57.33	1185.21	57.81	1185.21	58.41	1185.21	59.04	1185.21	59.64	1185.21
60.18	1185.2	65.23	1185.18	66.13	1185.17	66.83	1185.17	67.66	1185.16
68.09	1185.16	68.49	1185.15	69.47	1185.14	70.09	1185.13	70.83	1185.13
71.86	1185.11	72.58	1185.11	73.54	1185.09	74.3	1185.08	74.84	1185.07
75.13	1185.07	76.22	1185.09	76.51	1185.09	76.76	1185.09	76.95	1185.09
77.87	1185.03	78.87	1185.02	78.94	1185.02	79.01	1185.01	79.08	1185.01

80.17	1185	80.21	1184.99	80.26	1184.98	81.09	1184.84	81.55	1184.75
81.68	1184.73	81.88	1184.7	82.55	1184.59	83.2	1184.5	83.87	1184.5
84.05	1184.5	84.99	1184.5	85.51	1184.5	86.95	1184.55	92.17	1184.75
92.59	1184.75	92.62	1184.75	94.93	1184.83	96.03	1184.87	96.64	1184.89
96.99	1184.9	97.19	1184.9	97.31	1184.91	99.23	1184.91	112.07	1184.9
112.64	1184.91	113.45	1184.92	114.54	1184.94	115.98	1184.96	117.82	1184.98
118.91	1185	121.22	1185.03	123.33	1185.07	124.1	1185.08	124.66	1185.09
125.31	1185.1	125.86	1185.11	126.28	1185.12	128.58	1185.12	129	1185.11
129.52	1185.1	130.09	1185.09	130.54	1185.08	131.09	1185.08	132.2	1185.06
134.31	1185.04	136.17	1185	136.24	1185	137.4	1185	137.77	1185
139.25	1184.98	140.44	1184.97	144.17	1184.97	145.33	1184.99	145.99	1185
146.89	1185.02	146.98	1185.02	148.46	1185.04	148.76	1185.05	149.91	1185.07
150.43	1185.08	151.25	1185.09	151.99	1185.1	152.46	1185.11	153.36	1185.12
153.76	1185.13	154.31	1185.14	155.29	1185.16	156.19	1185.17	157.53	1185.2
159	1185.22	159.21	1185.23	160.27	1185.25	160.9	1185.26	162.07	1185.29
162.9	1185.3	163.49	1185.32	164.79	1185.33	165.3	1185.34	165.85	1185.34
166.36	1185.34	166.83	1185.35	170.72	1185.38	171.27	1185.38	181.56	1185.33
188.17	1185.49	188.52	1185.5	190.05	1185.54	191.39	1185.57	192.09	1185.58
192.43	1185.59	192.68	1185.6	193	1185.61	193.32	1185.61	196.64	1185.7
196.97	1185.7	197.42	1185.7	198.01	1185.7	198.73	1185.7	199.6	1185.7
213.87	1185.71	213.93	1185.71	213.99	1185.71	214.06	1185.71	214.21	1185.71
214.27	1185.72	214.4	1185.72	214.64	1185.72	215.16	1185.73	215.98	1185.74
216.51	1185.75	217.69	1185.77	219.77	1185.8	221.47	1185.83	223.81	1185.86
224.89	1185.88	226.02	1185.89	226.99	1185.91	229.83	1185.95	231.77	1185.91
232.15	1185.9	232.61	1185.89	233.14	1185.88	234.9	1185.83	235.94	1185.8
237.39	1185.75	238.04	1185.73	240.55	1185.65	244.21	1185.53	244.56	1185.52
244.74	1185.51	244.84	1185.51	245.11	1185.5	245.14	1185.5	247.7	1185.43
249.94	1185.39	251.02	1185.37	251.32	1185.36	252.09	1185.34	252.94	1185.33
254.21	1185.3	254.66	1185.29	256.38	1185.25	256.41	1185.25	256.43	1185.25
258.76	1185.18	259.51	1185.16	260.95	1185.11	262.53	1185.05	262.96	1185.04
263.81	1185	265.4	1184.92	265.95	1184.89	267.12	1184.83	267.55	1184.81
267.79	1184.8	268.05	1184.79	268.4	1184.78	268.46	1184.78	268.52	1184.78
268.64	1184.78	268.8	1184.77	269.15	1184.77	269.24	1184.77	269.88	1184.76
269.94	1184.76	270.93	1184.75	270.94	1184.75	271.54	1184.75	272.03	1184.75
272.04	1184.75	273.07	1184.74	273.08	1184.74	273.9	1184.74	274.26	1184.75
274.52	1184.75	274.98	1184.76	275.93	1184.79	276.24	1184.8	277.32	1184.84
278.17	1184.87	279.02	1184.9	279.64	1184.92	280.74	1184.96	281.02	1184.97
281.81	1185	285.08	1185.02	288.52	1185.04	290.76	1185.05	292.28	1185.06
293.34	1185.07	294.07	1185.07	294.56	1185.07	295.6	1185.1	301.3	1185.17
302.69	1185.19	304.84	1185.2	308.18	1185.24	309.8	1185.25	309.89	1185.25
320.78	1185.29	323.97	1185.3	325.21	1185.31	325.5	1185.31	325.75	1185.32
325.8	1185.32	325.86	1185.32	325.95	1185.32	326.05	1185.32	326.25	1185.33
326.61	1185.33	328.48	1185.37	334.73	1185.5	335.66	1185.52	345.05	1185.74
345.32	1185.75	349.16	1185.91	351.38	1186	354.79	1186.24	354.93	1186.25
354.95	1186.27	354.99	1186.35	355.15	1186.69	355.16	1186.74	355.17	1186.75
355.27	1186.96	355.28	1187	355.37	1187.17	355.4	1187.25	355.42	1187.28
355.46	1187.36	355.51	1187.48	355.52	1187.5	355.54	1187.55	355.64	1187.75
355.69	1187.86	355.76	1188	355.88	1188.25	356	1188.5	356.11	1188.74
356.12	1188.75	356.12	1188.76	356.24	1189	356.3	1189.13	356.36	1189.25
356.45	1189.45	356.47	1189.5	356.56	1189.68	356.59	1189.75	356.65	1189.87
356.71	1190	356.82	1190.25	356.92	1190.5	356.96	1190.63	357	1190.75
357.05	1190.88	357.09	1191	357.15	1191.18	357.17	1191.25	357.23	1191.44
357.26	1191.5	357.28	1191.58	357.32	1191.7	357.34	1191.75	357.36	1191.82
357.42	1192	357.5	1192.24	357.5	1192.25	357.56	1192.43	357.59	1192.5
357.65	1192.7	357.67	1192.75	357.71	1192.88	357.75	1193	357.81	1193.16
357.83	1193.25	358.19	1193.32	358.57	1193.4	359.02	1193.5	359.81	1193.69
360.09	1193.75	360.61	1193.88	361.1	1194	361.33	1194.06	362.07	1194.25
362.31	1194.31	362.48	1194.35	362.56	1194.38	362.64	1194.39	362.72	1194.41
363.98	1194.25	364.35	1194.25	364.8	1194.25	365.23	1194.25	372.21	1194.25
374.01	1194.3								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val

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       0     .03  229.83     .03  355.15     .03

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        229.83  355.15             25.99   25.41   24.87             .1       .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
       0      81    1187       F

CROSS SECTION


RIVER: Khowst
REACH: Reach1             RS: 323.9

INPUT
Description:
Station Elevation Data    num=     423
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 1185.84    6.62 1185.93    7.03 1185.94    7.37 1185.95     7.7 1185.95
    8.36 1185.96    9.25 1185.97    9.41 1185.98   10.32 1185.99   10.38 1185.99
   11.11    1186   11.12    1186    11.2    1186   11.21    1186   12.18    1186
   12.71    1186    13.1    1186   13.41    1186   13.79 1185.98   14.73 1185.92
   17.49 1185.76   17.71 1185.75   17.74 1185.75   17.75 1185.75   18.31  1185.5
    18.5 1185.42    18.7 1185.34   18.92 1185.25   18.98 1185.23   19.08 1185.19
   19.56 1185.14   19.69 1185.14   26.47 1185.25    27.8 1185.25   28.36 1185.25
   39.16 1185.12   39.75 1185.12   40.56 1185.12    41.1 1185.12   42.07 1185.11
    42.5 1185.11   42.81 1185.11   42.95 1185.12   44.01 1185.11   44.12 1185.11
   44.29 1185.11   44.46 1185.11   44.69 1185.11    44.8 1185.11   45.92 1185.11
   48.58 1185.12   49.46 1185.11    50.4 1185.11   51.34  1185.1   52.23 1185.09
   52.94 1185.09   53.36 1185.08   53.82 1185.08    54.6 1185.07   55.73 1185.06
   57.21 1185.05   59.08 1185.03   61.34 1185.01    61.6 1185.01   62.76    1185
   63.53 1184.96   64.27  1184.9   65.25 1184.83   65.88 1184.75    66.4 1184.59
   66.67  1184.5   67.12 1184.35   67.43 1184.25   67.95 1184.09   68.22    1184
   68.33    1184   69.42    1184   70.51 1184.06   71.09 1184.09   72.41 1184.15
   73.44 1184.21   74.31 1184.25   74.59 1184.26   74.66 1184.26   75.63 1184.29
   76.27 1184.31   76.61 1184.31   77.35 1184.33   78.02 1184.34   78.58 1184.35
   79.15 1184.36   79.86 1184.38   80.26 1184.38   80.47 1184.39   81.27 1184.41
   82.06 1184.42   82.23 1184.43   83.58 1184.47   84.41  1184.5   85.29 1184.53
    85.5 1184.54   87.16  1184.6   87.64 1184.62   88.03 1184.64   88.96 1184.67
   89.36 1184.68   90.34 1184.71   90.68 1184.72   92.07 1184.75   92.11 1184.75
   92.89 1184.76   99.79 1184.87  101.91 1184.91  102.87 1184.92  103.38 1184.93
  103.67 1184.94  103.81 1184.94  103.93 1184.94  104.09 1184.94  104.24 1184.95
  104.37 1184.95  104.46 1184.95  104.54 1184.95  104.59 1184.95  104.75 1184.96
  105.85 1184.96  118.27 1184.77  118.53 1184.77  118.83 1184.77  119.36 1184.76
  120.14 1184.75  120.57 1184.75  121.68 1184.74  123.39 1184.73  128.04 1184.71
  129.05 1184.71  130.13 1184.71  131.23 1184.72  132.25 1184.72  133.09 1184.72
  133.65 1184.73  134.17 1184.73  135.08 1184.74  136.22 1184.75   136.4 1184.75
  137.73 1184.77  138.98 1184.78  140.09 1184.79  141.02  1184.8  141.74 1184.81
     149 1184.89   151.4 1184.86  155.71 1184.92  156.57 1184.93  158.26 1184.95
  161.44    1185  162.56 1185.02  163.53 1185.03  164.19 1185.04  166.68 1185.07
  168.87  1185.1  180.91 1185.22  181.14 1185.22  186.94 1185.25  186.98 1185.25
  187.24 1185.25  187.29 1185.25  187.42 1185.25  187.62 1185.25  187.82 1185.25
  187.98 1185.25  188.16 1185.25  188.25 1185.25  188.34 1185.25   188.5 1185.25
  188.75 1185.26  190.51 1185.28  192.17  1185.3  193.74 1185.33  195.07 1185.35
  196.14 1185.36  202.66 1185.46  206.32 1185.47  212.85  1185.5  213.68  1185.5
  216.35  1185.5     217  1185.5  217.66  1185.5  217.78  1185.5  218.36  1185.5
   218.9  1185.5  219.25  1185.5  221.15 1185.48  221.44 1185.48  221.98 1185.48
  222.71 1185.48  224.48  1185.5   225.1  1185.5  225.79  1185.5  226.31  1185.5
  227.17  1185.5  227.46  1185.5  228.24  1185.5  228.62 1185.51  228.64 1185.51
   229.7 1185.53  229.72 1185.53  230.18 1185.54  238.82 1185.58  238.83 1185.58
  239.98 1185.55  241.55 1185.51  241.56 1185.51  242.16  1185.5  243.75 1185.46
  243.83 1185.46  243.92 1185.46  245.47 1185.42  245.73 1185.42  246.08 1185.41
     247 1185.39  247.97 1185.36   248.9 1185.34  249.29 1185.33  249.62 1185.32
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  251.37 1185.27  251.53 1185.27  252.17 1185.25  254.16 1185.15  256.93 1185.02
  257.14 1185.01  257.28    1185  259.83 1184.88  261.15 1184.81  262.51 1184.75
  263.25 1184.71  263.33 1184.71  264.33 1184.67  264.61 1184.66  265.47 1184.62
  265.96 1184.61  266.33  1184.6  266.59 1184.59  267.03 1184.58  267.39 1184.57
  267.64 1184.57  267.93 1184.56  268.57 1184.56  268.79 1184.55  269.76 1184.55
  270.31 1184.55  271.54 1184.54  271.74 1184.54  271.97 1184.54  273.35 1184.54
  273.57 1184.54  275.03 1184.54   275.2 1184.54  276.66 1184.54  276.76 1184.54
  276.82 1184.54  278.18 1184.53  279.33  1184.5  279.89  1184.5   280.5  1184.5
  280.76  1184.5  281.02  1184.5  281.16  1184.5  281.25  1184.5  281.32  1184.5
  283.01  1184.5  283.81  1184.5  284.17  1184.5  284.94 1184.54  288.78 1184.75
  292.57 1184.95  293.18 1184.98  293.73    1185  293.77    1185  293.79    1185
  293.89    1185   294.7 1185.02  295.48 1185.04   296.1 1185.06  296.54 1185.07
  303.96 1185.06  305.68 1185.07     307 1185.07  309.95 1185.11  315.95  1185.2
  316.11 1185.21   316.2 1185.21  316.24 1185.21  316.27 1185.21  316.39 1185.21
  316.66 1185.21  317.18 1185.21  318.05 1185.21   319.1 1185.22  320.24 1185.22
  321.37 1185.22  322.33 1185.22  323.65 1185.23  325.44 1185.24  326.38 1185.24
  327.61 1185.24   328.5 1185.24  329.39 1185.25  330.09 1185.25  330.43 1185.25
  330.66 1185.25  330.86 1185.25  332.74 1185.25  333.63 1185.25  335.06 1185.25
  335.12 1185.25  335.16 1185.25   335.3 1185.25  335.62 1185.24  339.09 1185.18
  341.27 1185.14  341.53 1185.14  346.04 1185.09  346.56 1185.09  346.85 1185.08
  347.19 1185.07  347.61 1185.07  347.77 1185.07  348.16 1185.07   349.6 1185.13
  350.34 1185.19  350.39 1185.19  350.46 1185.19  351.03 1185.25  352.43 1185.41
  353.19  1185.5     354 1185.62  355.26 1185.77  357.17    1186  357.21 1186.22
  357.21 1186.25  357.25 1186.35  357.25  1186.5  357.28 1186.71  357.29 1186.75
  357.29 1186.78  357.32 1186.97  357.33    1187  357.35 1187.18  357.36 1187.25
  357.36 1187.26   357.4  1187.5  357.41 1187.55  357.44 1187.75  357.46 1187.88
  357.47    1188  357.48 1188.06  357.49 1188.08  357.51 1188.25  357.53 1188.36
  357.55  1188.5  357.57 1188.61  357.59 1188.75  357.63 1188.95  357.64    1189
  357.67 1189.15  357.68 1189.25  357.69 1189.27  357.78  1189.5  357.84 1189.62
   357.9 1189.75  357.97 1189.88  358.02    1190  358.12 1190.19  358.15 1190.25
  358.16 1190.27  358.27  1190.5  358.38 1190.73  358.39 1190.75  358.42 1190.83
  358.49    1191  358.52 1191.07  358.57 1191.17   358.6 1191.25  358.72 1191.36
   358.9  1191.5  358.98 1191.53  359.65 1191.75  359.95 1191.84  360.49    1192
  360.85  1192.1  361.37 1192.25  361.83 1192.38  362.25  1192.5  362.92 1192.69
  363.13 1192.75   363.7 1192.75  364.47 1192.75   364.7 1192.52  364.72  1192.5
  365.09  1192.5  365.41  1192.5   365.9 1192.52  366.07 1192.53  367.16 1192.58
  367.89 1192.62  368.67 1192.66  370.05 1192.72  370.22 1192.73  370.64 1192.75
  371.55 1192.78  372.35  1192.8  372.73  1192.8  373.16 1192.81  373.54 1192.82
  374.09 1192.84  374.76 1192.85  375.39 1192.86  375.93 1192.87  377.18 1192.93
  377.92 1192.94   378.9 1192.87  379.39 1192.87

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .03  238.82     .03  357.28     .03

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        238.82  357.28            41.99   35.66   34.62             .1       .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
       0  114.14 1186.99       F
Blocked Obstructions     num=       1
   Sta L   Sta R    Elev
      87     114    1187

CROSS SECTION


RIVER: Khowst
REACH: Reach1             RS: 288.3

INPUT
Description:
Station Elevation Data    num=     376
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Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1185.36	.09	1185.36	.22	1185.36	.42	1185.37	1.29	1185.38
2.73	1185.39	5.13	1185.42	6.34	1185.44	7.4	1185.45	8.4	1185.47
8.61	1185.47	9.58	1185.49	9.64	1185.49	10.67	1185.5	11.05	1185.5
12.93	1185.53	14	1185.54	14.61	1185.55	14.96	1185.55	15.15	1185.56
16.75	1185.54	17.68	1185.51	17.97	1185.5	18.06	1185.5	18.12	1185.49
18.14	1185.49	18.76	1185.46	22.99	1185.25	24.63	1185.17	27.93	1185
31.06	1184.84	32.75	1184.75	33.59	1184.65	34.47	1184.54	34.78	1184.5
34.81	1184.49	35.31	1184.25	38.27	1184.2	49.47	1184.09	49.48	1184.09
51.53	1184.1	52.04	1184.1	55.81	1184.19	57.07	1184.23	57.59	1184.25
58.58	1184.29	60.09	1184.34	62.55	1184.43	64.54	1184.5	65.12	1184.52
65.74	1184.54	77.38	1184.54	79.92	1184.52	82.97	1184.53	83.78	1184.51
84.05	1184.5	84.29	1184.5	84.46	1184.5	84.57	1184.5	85.17	1184.5
85.41	1184.5	86.51	1184.48	87.1	1184.48	87.77	1184.48	88.33	1184.48
88.59	1184.48	88.77	1184.48	89.02	1184.48	89.19	1184.48	89.33	1184.48
89.59	1184.48	89.83	1184.47	89.98	1184.47	90.17	1184.47	90.59	1184.46
91.13	1184.45	92.49	1184.46	93.46	1184.45	100.52	1184.32	100.59	1184.32
100.76	1184.32	100.9	1184.32	101.38	1184.33	115.54	1184.49	115.9	1184.49
116.35	1184.5	116.85	1184.5	116.98	1184.5	117.36	1184.51	117.56	1184.51
117.7	1184.51	117.95	1184.51	118.23	1184.52	118.48	1184.52	118.68	1184.53
118.82	1184.53	124.3	1184.52	124.76	1184.52	125.2	1184.53	125.88	1184.53
126.67	1184.53	127.45	1184.53	136.04	1184.61	141.45	1184.55	144.09	1184.52
144.17	1184.52	145.64	1184.55	145.66	1184.55	145.91	1184.56	146.28	1184.57
146.8	1184.58	146.83	1184.58	147.59	1184.6	147.69	1184.6	148.8	1184.63
149.05	1184.64	149.49	1184.65	150.95	1184.69	151.38	1184.7	152.82	1184.73
153.41	1184.75	153.77	1184.76	153.85	1184.76	154.75	1184.78	155.85	1184.81
156.5	1184.83	157.67	1184.86	158.92	1184.88	159.89	1184.9	161.79	1184.93
162.35	1184.95	164.76	1184.99	165.18	1185	165.57	1185	166.84	1185.01
168.12	1185.01	170.38	1185.03	171.51	1185.03	172.71	1185.03	173.88	1185.04
174.95	1185.04	178.45	1185.09	179.47	1185.1	180.45	1185.11	182.78	1185.12
183.82	1185.14	185.19	1185.16	186.92	1185.19	187.41	1185.2	187.63	1185.2
189.22	1185.23	189.33	1185.23	190.11	1185.25	191.38	1185.25	191.75	1185.25
194.06	1185.25	200.91	1185.28	201.89	1185.27	202.66	1185.27	203.03	1185.27
203.35	1185.27	204.75	1185.28	205.13	1185.28	205.21	1185.28	205.59	1185.27
205.83	1185.27	205.88	1185.27	206.16	1185.27	206.88	1185.26	206.9	1185.26
208.03	1185.25	208.33	1185.25	209.82	1185.24	209.89	1185.24	211.85	1185.23
211.98	1185.22	212.1	1185.22	214.02	1185.21	219.75	1185.14	220.99	1185.13
221.76	1185.12	222.26	1185.12	222.55	1185.12	222.68	1185.11	222.8	1185.11
222.98	1185.11	223.19	1185.11	223.39	1185.11	223.57	1185.11	223.71	1185.11
223.88	1185.11	224.03	1185.11	224.25	1185.11	224.52	1185.11	224.83	1185.11
225.15	1185.12	235.42	1185.16	235.55	1185.16	235.64	1185.16	235.69	1185.16
235.72	1185.16	235.73	1185.16	235.74	1185.16	236.85	1185.1	237.39	1185.06
238.27	1185	239.79	1184.89	240.89	1184.81	241.65	1184.75	243.43	1184.62
244.43	1184.55	245.05	1184.5	247.29	1184.34	248.48	1184.25	248.95	1184.22
249.55	1184.17	249.78	1184.16	249.88	1184.15	249.97	1184.14	250.1	1184.14
251.65	1184.15	253.32	1184.2	255.33	1184.25	257.11	1184.3	258.68	1184.34
259.37	1184.36	260.4	1184.39	264.39	1184.48	265.18	1184.5	265.2	1184.5
265.29	1184.5	270.64	1184.65	271.99	1184.69	272.98	1184.72	273.92	1184.75
273.94	1184.75	278.14	1184.87	278.24	1184.87	278.28	1184.87	278.3	1184.87
278.31	1184.87	278.32	1184.87	278.33	1184.87	290.64	1184.98	291.31	1184.99
291.37	1184.99	292.08	1184.99	292.44	1184.99	292.74	1185	293.08	1185
293.18	1185	293.71	1185	294.34	1185.01	294.56	1185.01	297.32	1185.02
303.5	1185.04	303.77	1185.04	304.78	1185.05	305.66	1185.05	306.37	1185.05
308.38	1185.05	309.03	1185.05	309.78	1185.04	310.58	1185.04	311.37	1185.04
312.08	1185.04	313.16	1185.03	314.37	1185.02	316.49	1185.01	317.3	1185
323.15	1185	327.39	1185	328.63	1185	336.98	1185.05	337.2	1185.12
337.74	1185.1	337.88	1185.12	337.99	1185.13	338.13	1185.14	338.36	1185.16
338.67	1185.15	338.86	1185.18	339.22	1185.25	339.25	1185.39	339.27	1185.5
339.29	1185.64	339.3	1185.75	339.31	1185.87	339.32	1186	339.33	1186.13
339.33	1186.23	339.34	1186.25	339.35	1186.25	339.99	1186.25	340.01	1186.25
340.02	1186.25	340.03	1186.18	340.06	1186	340.09	1185.8	340.1	1185.75
340.13	1185.62	340.15	1185.5	340.17	1185.4	340.19	1185.25	340.84	1185.01
340.86	1185	340.88	1185	340.88	1185.01	340.9	1185	340.99	1185

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  341.07    1185  341.09 1185.09   341.1 1185.22  341.11 1185.25  341.11 1185.27
  341.14  1185.5  341.15 1185.55  341.18 1185.75  341.21 1185.94  341.21 1185.98
  341.22    1186  341.27 1186.02  341.91 1186.25  342.08 1186.49  342.09  1186.5
   342.1 1186.51  342.34 1186.75  342.51 1186.92  342.59    1187  342.72 1187.13
  342.84 1187.25  342.95 1187.36  343.09  1187.5  343.25 1187.66  343.35 1187.75
  343.59 1187.99   343.6    1188  343.61 1188.01  343.64 1188.04  343.86 1188.25
   343.9 1188.29  344.12  1188.5   344.2 1188.58  344.37 1188.75  344.49 1188.86
  344.63    1189  344.78 1189.16  344.88 1189.25  345.19 1189.32  345.88  1189.5
  346.35 1189.61  346.97 1189.75  348.03    1190  348.04    1190  349.11 1190.25
  349.17 1190.25  349.59 1190.33  349.85 1190.34  349.99 1190.35  350.11 1190.36
  350.33 1190.37  350.94  1190.5  351.01  1190.5  351.74 1190.68  352.03 1190.75
  352.38 1190.82  353.28    1191  353.77 1191.05  354.13 1191.06  355.07 1191.12
   356.2 1191.14  356.86 1191.17  358.77  1191.2  359.09 1191.21  359.26 1191.22
  359.73 1191.22

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .03  204.75     .03  339.34     .03

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        204.75  339.34            35.93   34.74   33.46             .1       .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
       0  126.64 1187.49       F
Right Levee     Station=  340.01      Elevation= 1186.25
Blocked Obstructions     num=       1
   Sta L   Sta R    Elev
     100     127  1187.5

CROSS SECTION


RIVER: Khowst
REACH: Reach1             RS: 253.5

INPUT
Description:
Station Elevation Data    num=     202
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 1184.73    1.28 1184.74    3.11 1184.75    3.67 1184.76    7.21 1184.84
     8.3 1184.86   10.29 1184.91   11.06 1184.92   11.79 1184.94   14.42    1185
   14.58    1185   15.85 1185.03   17.38 1185.05   17.94 1185.07   30.03    1185
   46.51    1185   46.68 1184.75   46.98    1184   47.22  1183.5   50.22  1183.5
   50.49 1183.52   52.63 1183.62   54.87 1183.75   57.28  1183.9   58.94    1184
   62.64 1184.13   63.15 1184.15    63.4 1184.15   64.12 1184.18   65.42 1184.22
   66.26 1184.23   67.41 1184.25   81.13 1184.25   81.84 1184.24   81.92 1184.23
   85.48 1184.16   86.08 1184.14   87.17 1184.12   87.51 1184.11   90.97 1184.07
   91.11 1184.07   97.58 1184.13   98.91 1184.16  100.55 1184.19  103.44 1184.25
  112.41 1184.25  116.26 1184.15  117.13 1184.14   118.1 1184.12  118.49 1184.12
   119.1 1184.11  119.31  1184.1  120.92 1184.08  121.88 1184.06  122.16 1184.06
   124.5 1184.04  125.07 1184.06  126.22 1184.08  127.41 1184.11  128.22 1184.12
  128.92 1184.14  129.47 1184.15     1301184.163  130.031184.164  131.09 1184.19
  132.94 1184.22  133.12 1184.23  134.38 1184.25  135.25 1184.27  135.36 1184.28
  136.92 1184.32  138.57 1184.37  140.23  1184.4  141.02 1184.42  141.78 1184.43
  142.16 1184.43  145.17 1184.46  145.78 1184.47  146.35 1184.47  146.44 1184.48
  148.32  1184.5  152.53  1184.5  160.14  1184.5  162.99  1184.6  168.09 1184.75
   184.8 1184.75  186.81 1184.73  187.87 1184.71  188.95  1184.7  189.88 1184.68
  190.17 1184.68  191.69 1184.66  192.45 1184.64  194.01 1184.63   199.2 1184.63
  202.36 1184.64  202.57 1184.65  203.58 1184.66  205.24 1184.69  208.13 1184.75
   208.3 1184.75  210.65 1184.78  210.91 1184.78  213.14  1184.8  213.59 1184.81
  215.49 1184.83  216.04 1184.83  217.61 1184.84  218.13 1184.85  218.63 1184.85
  220.88 1184.87  224.22 1184.88   227.1 1184.88   227.4 1184.87  229.11 1184.87
   229.8 1184.86  231.46 1184.86  235.48 1184.85  236.02 1184.85  241.19 1184.81
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  241.44 1184.81  242.31 1184.79  243.49 1184.78  244.12 1184.77  245.51 1184.73
  246.51 1184.68  248.68  1184.6   250.8  1184.5  251.39 1184.47  255.55 1184.25
  257.14 1184.25  260.34 1184.32  265.57 1184.44  268.48  1184.5  278.97  1184.5
  283.27 1184.56  284.39 1184.56  284.49 1184.57  285.54 1184.57  286.09 1184.58
  286.85 1184.58  287.18 1184.59  287.72 1184.59  288.11  1184.6  288.53  1184.6
  288.76 1184.61  289.77 1184.62   290.2 1184.63  290.72 1184.63  290.93 1184.64
  291.41 1184.64  291.55 1184.65  298.72 1184.74  298.89 1184.75   319.4 1184.75
  329.84 1184.55  331.03 1184.52  331.33 1184.52  331.89  1184.5  342.56  1184.5
  342.72 1184.75   343.3    1185  343.84 1185.25  344.01 1185.27  344.84 1185.42
  345.05  1185.5  345.13  1185.5  347.24 1185.75  347.93 1185.83  349.48    1186
  352.25    1186  352.36 1185.75  352.41  1185.5  352.44 1185.25  352.51    1185
  353.67    1185  353.77 1185.25  353.95 1185.77  354.02    1186  355.14  1186.1
  357.23 1186.25  357.37 1186.33  357.73  1186.5  358.01  1186.6  358.61 1186.83
  359.25 1187.06  359.76 1187.25  360.08 1187.38  361.34 1187.86  362.53 1188.33
  363.05 1188.53  363.61 1188.76  364.32 1189.04  365.15 1189.38  365.46  1189.5
  366.06 1189.75  366.51 1189.89  367.06    1190  367.65 1190.09  369.44 1190.38
   370.5 1190.54  372.68 1190.89

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .03   227.4     .03  349.48     .03

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         227.4  349.48              6.65    6.77    6.89             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  140.82 1186.98        F
     341  372.68    1187        F
Blocked Obstructions     num=       1
   Sta L   Sta R    Elev
     114     141    1187

CROSS SECTION


RIVER: Khowst
REACH: Reach1             RS: 246.8

INPUT
Description:
Station Elevation Data    num=     200
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 1184.72    4.16 1184.81    4.91 1184.83    8.03  1184.9    9.52 1184.94
    11.4 1184.98   12.01    1185   41.81    1185   42.07 1184.94   42.97 1184.75
   44.15 1184.54   44.36 1184.54   44.69 1184.75   44.83 1184.75   45.44  1183.5
   49.27  1183.5   51.88 1183.65   53.51 1183.75   53.94 1183.78   55.12 1183.85
   57.48    1184   57.67    1184   59.92 1184.06   61.29 1184.09   61.88 1184.09
   62.81 1184.12   63.45 1184.12    65.8 1184.16   66.88 1184.16   67.19 1184.17
   68.63 1184.17   68.84 1184.18   70.04 1184.18   70.23 1184.19   72.96 1184.19
   74.19 1184.17   74.66 1184.17   75.93 1184.15   76.52 1184.15   77.27 1184.14
   78.17 1184.12   78.89 1184.12   79.09 1184.11   79.66  1184.1   80.17  1184.1
   84.79 1184.02   85.65    1184   87.23    1184   97.67 1184.19   98.76 1184.22
   98.97 1184.22  100.05 1184.25  106.21 1184.25  107.65  1184.2  108.79 1184.17
  110.66 1184.11  112.78 1184.05  114.45    1184     124    1184  124.96 1184.03
  125.28 1184.03  126.82 1184.08  128.15  1184.1  129.55 1184.13  136.14 1184.25
  137.72 1184.25   138.2 1184.28  138.47 1184.28   145.7 1184.36  152.93 1184.46
  154.74 1184.49  155.79  1184.5  159.78  1184.6  160.21 1184.62  161.34 1184.64
  164.55 1184.73  165.41 1184.75  167.78 1184.75  170.58 1184.72  171.02 1184.71
  171.64 1184.71  172.35  1184.7  172.62 1184.69  173.75 1184.68  174.61 1184.66
  174.79 1184.66  176.14 1184.64  176.33 1184.65  177.06 1184.64   177.3 1184.63
  178.44 1184.63  183.99  1184.6  185.18 1184.57  185.77 1184.57  186.91 1184.54
  187.11 1184.54   189.2  1184.5   199.5  1184.5  200.34 1184.52  200.55 1184.52
  202.02 1184.55  202.77 1184.56  203.27 1184.58  204.74  1184.6   205.7 1184.63
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  206.58 1184.65  209.29 1184.69  209.84 1184.71  210.22 1184.71  212.92 1184.75
  213.16 1184.75  214.85 1184.77  220.73 1184.79  224.57 1184.79  225.06 1184.78
  227.61 1184.78  228.77 1184.77  230.97 1184.77  233.07 1184.75  235.81 1184.75
  238.31 1184.67  238.77 1184.65   240.2  1184.6  240.83 1184.57  242.87  1184.5
  245.29 1184.43   246.6 1184.38  248.06 1184.33  248.56 1184.31  249.19 1184.28
  249.36 1184.28  250.07 1184.25  251.35 1184.25  257.93 1184.37  260.62 1184.41
   263.8 1184.46  264.61 1184.48  266.08  1184.5  267.77  1184.5  269.12 1184.49
  270.67 1184.49  272.23 1184.48   277.1  1184.5  283.73  1184.5  289.44 1184.58
  291.77 1184.61  293.16 1184.62  301.03 1184.75  313.34 1184.75  315.02 1184.72
  316.93 1184.69  317.17 1184.69  318.87 1184.67  320.37 1184.65  329.54 1184.69
  330.62 1184.75   333.2 1184.93  334.14    1185  334.32    1185  335.08 1184.97
  335.63    1185  336.43    1185  337.31 1185.24  337.55 1185.27   339.9 1185.46
  340.45  1185.5  342.32 1185.65  343.59 1185.75   345.3 1185.92  346.03    1186
  348.01    1186  348.07 1185.92   348.5 1185.25  348.56    1185  350.25    1185
  350.36 1185.25  350.57 1185.79  350.64    1186  351.25 1186.06  353.47  1186.2
   354.2 1186.25  354.51 1186.29  356.81  1186.5  357.36 1186.75  358.52 1187.25
  359.11  1187.5  359.55 1187.67  360.16 1187.89  360.55 1188.02  361.77 1188.21
  363.13 1188.41   363.8  1188.5  365.17 1188.69  365.44 1188.73  366.66 1188.89
  367.34    1189  368.71 1189.25  369.03  1189.3  370.17 1189.49  370.53 1189.54

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .03  235.81     .03  346.03     .03

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        235.81  346.03              4.5     4.5     4.5             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0     135    1187       F
     330  370.53    1187       F
Right Levee     Station=  348.03      Elevation= 1186.01
Blocked Obstructions     num=       1
   Sta L   Sta R    Elev
     108     135    1187

CROSS SECTION


RIVER: Khowst
REACH: Reach1             RS: 242.3

INPUT
Description:
Station Elevation Data    num=     417
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 1184.71    1.53 1184.75    1.81 1184.76    1.88 1184.76    1.99 1184.76
    5.51 1184.85    6.41 1184.87    7.38  1184.9   10.69 1184.99   10.78 1184.99
   11.57    1185   11.66    1185   13.36 1185.03   14.41 1185.06    14.8 1185.06
   18.56 1185.14   22.47 1185.17   35.83 1185.06   37.98    1185   38.31    1185
   38.82 1185.06   38.84 1185.06   38.87 1185.05   38.89 1185.05    38.9 1185.05
   38.92 1185.05      39 1185.04   39.38 1185.02   39.55    1185   39.63    1185
   40.13 1184.97   40.21 1184.97   40.93 1184.93   41.23 1184.91   41.75 1184.88
   42.27 1184.85    42.5 1184.84    42.6 1184.83   43.27  1184.8   43.29  1184.8
   43.85 1184.77   43.86 1184.77   44.17 1184.75   44.25 1184.75   44.32 1184.75
   44.34 1184.75   44.37 1184.75    44.6 1184.75   44.69 1184.57   44.72  1184.5
   44.81 1184.34   44.85 1184.25   44.92 1184.09   44.97    1184   45.01 1183.91
   45.09 1183.75   45.16  1183.6   45.21  1183.5   45.29 1183.28    45.3 1183.25
   45.37 1183.25   45.45 1183.25   45.47 1183.25   45.48 1183.25   46.74 1183.33
   46.97 1183.34   47.29 1183.36   48.01  1183.4   48.82 1183.45   49.02 1183.46
   49.61  1183.5   50.29 1183.54   50.94 1183.58      52 1183.65    52.4 1183.67
   53.61 1183.75   54.11 1183.78   55.14 1183.85   56.65 1183.95   56.89 1183.96
    57.5    1184   57.56    1184   58.72 1184.04   58.83 1184.04   61.79 1184.06
   62.43 1184.07   62.65 1184.07   68.48  1184.1    68.6  1184.1   68.65  1184.1
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68.7	1184.1	68.77	1184.1	68.84	1184.1	68.88	1184.1	68.91	1184.1
68.99	1184.1	69.08	1184.1	69.17	1184.11	69.24	1184.11	69.31	1184.11
69.45	1184.11	69.54	1184.1	69.68	1184.1	69.9	1184.1	70.3	1184.1
71.1	1184.09	76.35	1184.04	76.49	1184.03	78.03	1184.01	78.08	1184.01
78.12	1184.01	79.07	1184	80.06	1183.99	86.48	1184	86.68	1184
86.75	1184	86.78	1184	87.21	1184	87.29	1184	88.81	1184.03
88.89	1184.03	89.06	1184.03	90.58	1184.06	90.91	1184.06	92.03	1184.08
92.39	1184.09	93.08	1184.1	93.25	1184.11	93.3	1184.11	93.57	1184.11
93.77	1184.11	94.07	1184.12	94.35	1184.12	94.52	1184.13	94.75	1184.13
95.27	1184.14	95.91	1184.15	96.07	1184.15	96.46	1184.16	96.91	1184.17
97.49	1184.18	97.78	1184.18	98.11	1184.19	98.79	1184.2	99.18	1184.21
99.98	1184.22	100.61	1184.23	100.77	1184.23	101.1	1184.24	101.24	1184.24
101.32	1184.24	101.63	1184.24	101.66	1184.24	101.79	1184.23	101.83	1184.23
102.09	1184.23	102.29	1184.22	102.76	1184.21	103.53	1184.19	104.85	1184.15
105.87	1184.11	106.52	1184.09	109.64	1184	109.68	1184	109.69	1184
112.1	1184	112.37	1184	117.1	1183.93	117.54	1183.94	118.04	1183.94
121.32	1183.99	121.87	1184	125.38	1184.07	127.78	1184.11	135.23	1184.25
137.24	1184.27	139.96	1184.29	153.04	1184.46	154.11	1184.49	154.41	1184.5
155.25	1184.52	155.3	1184.52	158.01	1184.59	162.52	1184.67	162.89	1184.66
163.24	1184.66	163.54	1184.66	163.74	1184.66	163.94	1184.66	164.07	1184.66
164.42	1184.65	164.66	1184.65	165.15	1184.65	165.39	1184.64	165.54	1184.64
165.73	1184.64	166.37	1184.63	166.77	1184.63	167.25	1184.63	168.01	1184.62
168.47	1184.61	169.32	1184.61	169.68	1184.6	169.89	1184.6	170.77	1184.59
170.94	1184.59	171.25	1184.58	172.08	1184.58	172.42	1184.57	173.08	1184.57
173.41	1184.56	173.8	1184.56	176	1184.55	176.36	1184.55	176.92	1184.55
177.54	1184.56	178.14	1184.56	181.6	1184.55	182.83	1184.53	184.84	1184.5
184.94	1184.5	185.04	1184.5	187	1184.47	188	1184.45	196.29	1184.45
197.25	1184.46	198.97	1184.49	199.6	1184.5	200.09	1184.51	200.32	1184.52
202.62	1184.57	204.18	1184.6	205.71	1184.62	206.9	1184.65	208.79	1184.67
209.52	1184.69	214.36	1184.75	214.43	1184.75	214.45	1184.75	214.48	1184.75
214.54	1184.75	214.58	1184.75	214.59	1184.75	214.62	1184.75	215.34	1184.76
215.54	1184.76	215.69	1184.76	215.83	1184.75	216.05	1184.75	216.76	1184.75
217.05	1184.75	217.79	1184.75	217.8	1184.75	218.95	1184.74	218.96	1184.74
220.18	1184.74	220.2	1184.74	221.37	1184.74	221.4	1184.74	222.44	1184.73
222.5	1184.73	223.31	1184.73	223.81	1184.73	223.91	1184.73	224.41	1184.73
224.54	1184.73	225.32	1184.72	226.26	1184.72	226.44	1184.72	227.46	1184.71
227.67	1184.71	228.67	1184.7	228.89	1184.7	232.29	1184.7	232.4	1184.7
232.47	1184.7	232.54	1184.7	232.67	1184.7	232.81	1184.7	234.29	1184.68
235.09	1184.65	237.07	1184.59	237.56	1184.57	239.7	1184.5	245.52	1184.31
247.54	1184.25	248.82	1184.25	248.95	1184.25	249.06	1184.25	249.09	1184.25
254.7	1184.35	257.45	1184.39	259.02	1184.42	260	1184.43	263.18	1184.46
263.46	1184.47	263.73	1184.47	263.97	1184.47	264.17	1184.47	265.51	1184.46
265.7	1184.46	265.93	1184.46	267.11	1184.46	268.42	1184.46	269.77	1184.45
283.96	1184.5	284.43	1184.5	284.51	1184.5	285.14	1184.51	285.67	1184.52
287.98	1184.55	289.57	1184.58	290.66	1184.59	300.82	1184.75	300.86	1184.75
300.94	1184.75	301.04	1184.75	301.2	1184.75	301.25	1184.75	301.52	1184.75
301.59	1184.75	302.19	1184.75	302.36	1184.75	303.36	1184.75	303.6	1184.75
304.76	1184.75	305.82	1184.75	306.26	1184.75	307.31	1184.75	307.72	1184.75
310.51	1184.75	311.76	1184.75	313.91	1184.72	320.64	1184.75	327.26	1184.75
328.66	1184.86	330.65	1185	331.98	1185.09	333.22	1185.18	334.1	1185.24
334.19	1185.25	335.79	1185.38	336.83	1185.46	337.12	1185.49	337.27	1185.5
339.16	1185.65	340.38	1185.75	340.52	1185.76	342.49	1185.92	343.36	1185.99
343.44	1185.99	343.52	1186	344.87	1186.11	345.73	1186.08	345.78	1186
345.87	1185.87	345.94	1185.75	346.1	1185.51	346.11	1185.5	346.15	1185.43
346.24	1185.29	346.27	1185.25	346.29	1185.22	346.39	1185.06	346.43	1185
346.49	1185	348.32	1185	348.42	1185.23	348.43	1185.25	348.47	1185.35
348.53	1185.5	348.6	1185.68	348.62	1185.72	348.63	1185.75	348.7	1185.93
348.72	1186	348.89	1186.04	350.01	1186.25	351.05	1186.29	351.15	1186.3
351.26	1186.3	351.48	1186.31	352.96	1186.37	355.12	1186.5	355.2	1186.5
355.41	1186.5	355.64	1186.6	355.77	1186.66	355.97	1186.75	356.41	1186.94
356.56	1187	357.04	1187.18	357.23	1187.25	357.43	1187.3	357.82	1187.37
358.64	1187.5	358.79	1187.52	359.38	1187.61	360.14	1187.72	360.25	1187.73
360.37	1187.75	361.89	1187.97	362	1187.99	362.1	1188	363.51	1188.2

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  363.86 1188.25  364.85 1188.39  365.68  1188.5  365.93 1188.53     366 1188.54
  366.14 1188.57   366.8 1188.66  367.32 1188.75  367.38 1188.76  367.49 1188.78
   368.2 1188.92  368.59 1188.99

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .03  228.89     .03  344.87     .03

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        228.89  344.87             13.2    13.2    13.2             .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0     135    1187       F
     330  368.59    1187       F
Blocked Obstructions     num=       1
   Sta L   Sta R    Elev
     108     135    1187

BRIDGE


RIVER: Khowst
REACH: Reach1             RS: 235.7

INPUT
Description:
Distance from Upstream XS =       2
Deck/Roadway Width        =     8.4
Weir Coefficient          =     1.4
Upstream  Deck/Roadway Coordinates
    num=       6
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
       0 1188.39             135 1188.39          135.01 1188.39 1186.89
     330 1188.39 1186.89  330.01 1188.39             370 1188.39

Upstream Bridge Cross Section Data
Station Elevation Data    num=     417
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 1184.71    1.53 1184.75    1.81 1184.76    1.88 1184.76    1.99 1184.76
    5.51 1184.85    6.41 1184.87    7.38  1184.9   10.69 1184.99   10.78 1184.99
   11.57    1185   11.66    1185   13.36 1185.03   14.41 1185.06    14.8 1185.06
   18.56 1185.14   22.47 1185.17   35.83 1185.06   37.98    1185   38.31    1185
   38.82 1185.06   38.84 1185.06   38.87 1185.05   38.89 1185.05    38.9 1185.05
   38.92 1185.05      39 1185.04   39.38 1185.02   39.55    1185   39.63    1185
   40.13 1184.97   40.21 1184.97   40.93 1184.93   41.23 1184.91   41.75 1184.88
   42.27 1184.85    42.5 1184.84    42.6 1184.83   43.27  1184.8   43.29  1184.8
   43.85 1184.77   43.86 1184.77   44.17 1184.75   44.25 1184.75   44.32 1184.75
   44.34 1184.75   44.37 1184.75    44.6 1184.75   44.69 1184.57   44.72  1184.5
   44.81 1184.34   44.85 1184.25   44.92 1184.09   44.97    1184   45.01 1183.91
   45.09 1183.75   45.16  1183.6   45.21  1183.5   45.29 1183.28    45.3 1183.25
   45.37 1183.25   45.45 1183.25   45.47 1183.25   45.48 1183.25   46.74 1183.33
   46.97 1183.34   47.29 1183.36   48.01  1183.4   48.82 1183.45   49.02 1183.46
   49.61  1183.5   50.29 1183.54   50.94 1183.58      52 1183.65    52.4 1183.67
   53.61 1183.75   54.11 1183.78   55.14 1183.85   56.65 1183.95   56.89 1183.96
    57.5    1184   57.56    1184   58.72 1184.04   58.83 1184.04   61.79 1184.06
   62.43 1184.07   62.65 1184.07   68.48  1184.1    68.6  1184.1   68.65  1184.1
    68.7  1184.1   68.77  1184.1   68.84  1184.1   68.88  1184.1   68.91  1184.1
   68.99  1184.1   69.08  1184.1   69.17 1184.11   69.24 1184.11   69.31 1184.11
   69.45 1184.11   69.54  1184.1   69.68  1184.1    69.9  1184.1    70.3  1184.1
    71.1 1184.09   76.35 1184.04   76.49 1184.03   78.03 1184.01   78.08 1184.01
   78.12 1184.01   79.07    1184   80.06 1183.99   86.48    1184   86.68    1184
   86.75    1184   86.78    1184   87.21    1184   87.29    1184   88.81 1184.03
   88.89 1184.03   89.06 1184.03   90.58 1184.06   90.91 1184.06   92.03 1184.08
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92.39	1184.09	93.08	1184.1	93.25	1184.11	93.3	1184.11	93.57	1184.11
93.77	1184.11	94.07	1184.12	94.35	1184.12	94.52	1184.13	94.75	1184.13
95.27	1184.14	95.91	1184.15	96.07	1184.15	96.46	1184.16	96.91	1184.17
97.49	1184.18	97.78	1184.18	98.11	1184.19	98.79	1184.2	99.18	1184.21
99.98	1184.22	100.61	1184.23	100.77	1184.23	101.1	1184.24	101.24	1184.24
101.32	1184.24	101.63	1184.24	101.66	1184.24	101.79	1184.23	101.83	1184.23
102.09	1184.23	102.29	1184.22	102.76	1184.21	103.53	1184.19	104.85	1184.15
105.87	1184.11	106.52	1184.09	109.64	1184	109.68	1184	109.69	1184
112.1	1184	112.37	1184	117.1	1183.93	117.54	1183.94	118.04	1183.94
121.32	1183.99	121.87	1184	125.38	1184.07	127.78	1184.11	135.23	1184.25
137.24	1184.27	139.96	1184.29	153.04	1184.46	154.11	1184.49	154.41	1184.5
155.25	1184.52	155.3	1184.52	158.01	1184.59	162.52	1184.67	162.89	1184.66
163.24	1184.66	163.54	1184.66	163.74	1184.66	163.94	1184.66	164.07	1184.66
164.42	1184.65	164.66	1184.65	165.15	1184.65	165.39	1184.64	165.54	1184.64
165.73	1184.64	166.37	1184.63	166.77	1184.63	167.25	1184.63	168.01	1184.62
168.47	1184.61	169.32	1184.61	169.68	1184.6	169.89	1184.6	170.77	1184.59
170.94	1184.59	171.25	1184.58	172.08	1184.58	172.42	1184.57	173.08	1184.57
173.41	1184.56	173.8	1184.56	176	1184.55	176.36	1184.55	176.92	1184.55
177.54	1184.56	178.14	1184.56	181.6	1184.55	182.83	1184.53	184.84	1184.5
184.94	1184.5	185.04	1184.5	187	1184.47	188	1184.45	196.29	1184.45
197.25	1184.46	198.97	1184.49	199.6	1184.5	200.09	1184.51	200.32	1184.52
202.62	1184.57	204.18	1184.6	205.71	1184.62	206.9	1184.65	208.79	1184.67
209.52	1184.69	214.36	1184.75	214.43	1184.75	214.45	1184.75	214.48	1184.75
214.54	1184.75	214.58	1184.75	214.59	1184.75	214.62	1184.75	215.34	1184.76
215.54	1184.76	215.69	1184.76	215.83	1184.75	216.05	1184.75	216.76	1184.75
217.05	1184.75	217.79	1184.75	217.8	1184.75	218.95	1184.74	218.96	1184.74
220.18	1184.74	220.2	1184.74	221.37	1184.74	221.4	1184.74	222.44	1184.73
222.5	1184.73	223.31	1184.73	223.81	1184.73	223.91	1184.73	224.41	1184.73
224.54	1184.73	225.32	1184.72	226.26	1184.72	226.44	1184.72	227.46	1184.71
227.67	1184.71	228.67	1184.7	228.89	1184.7	232.29	1184.7	232.4	1184.7
232.47	1184.7	232.54	1184.7	232.67	1184.7	232.81	1184.7	234.29	1184.68
235.09	1184.65	237.07	1184.59	237.56	1184.57	239.7	1184.5	245.52	1184.31
247.54	1184.25	248.82	1184.25	248.95	1184.25	249.06	1184.25	249.09	1184.25
254.7	1184.35	257.45	1184.39	259.02	1184.42	260	1184.43	263.18	1184.46
263.46	1184.47	263.73	1184.47	263.97	1184.47	264.17	1184.47	265.51	1184.46
265.7	1184.46	265.93	1184.46	267.11	1184.46	268.42	1184.46	269.77	1184.45
283.96	1184.5	284.43	1184.5	284.51	1184.5	285.14	1184.51	285.67	1184.52
287.98	1184.55	289.57	1184.58	290.66	1184.59	300.82	1184.75	300.86	1184.75
300.94	1184.75	301.04	1184.75	301.2	1184.75	301.25	1184.75	301.52	1184.75
301.59	1184.75	302.19	1184.75	302.36	1184.75	303.36	1184.75	303.6	1184.75
304.76	1184.75	305.82	1184.75	306.26	1184.75	307.31	1184.75	307.72	1184.75
310.51	1184.75	311.76	1184.75	313.91	1184.72	320.64	1184.75	327.26	1184.75
328.66	1184.86	330.65	1185	331.98	1185.09	333.22	1185.18	334.1	1185.24
334.19	1185.25	335.79	1185.38	336.83	1185.46	337.12	1185.49	337.27	1185.5
339.16	1185.65	340.38	1185.75	340.52	1185.76	342.49	1185.92	343.36	1185.99
343.44	1185.99	343.52	1186	344.87	1186.11	345.73	1186.08	345.78	1186
345.87	1185.87	345.94	1185.75	346.1	1185.51	346.11	1185.5	346.15	1185.43
346.24	1185.29	346.27	1185.25	346.29	1185.22	346.39	1185.06	346.43	1185
346.49	1185	348.32	1185	348.42	1185.23	348.43	1185.25	348.47	1185.35
348.53	1185.5	348.6	1185.68	348.62	1185.72	348.63	1185.75	348.7	1185.93
348.72	1186	348.89	1186.04	350.01	1186.25	351.05	1186.29	351.15	1186.3
351.26	1186.3	351.48	1186.31	352.96	1186.37	355.12	1186.5	355.2	1186.5
355.41	1186.5	355.64	1186.6	355.77	1186.66	355.97	1186.75	356.41	1186.94
356.56	1187	357.04	1187.18	357.23	1187.25	357.43	1187.3	357.82	1187.37
358.64	1187.5	358.79	1187.52	359.38	1187.61	360.14	1187.72	360.25	1187.73
360.37	1187.75	361.89	1187.97	362	1187.99	362.1	1188	363.51	1188.2
363.86	1188.25	364.85	1188.39	365.68	1188.5	365.93	1188.53	366	1188.54
366.14	1188.57	366.8	1188.66	367.32	1188.75	367.38	1188.76	367.49	1188.78
368.2	1188.92	368.59	1188.99						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	228.89	.03	344.87	.03

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Bank Sta: Left   Right    Coeff Contr.   Expan.
        228.89  344.87             .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0     135    1187       F
     330  368.59    1187       F
Blocked Obstructions     num=       1
   Sta L   Sta R    Elev
     108     135    1187

Downstream  Deck/Roadway Coordinates
    num=       6
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
       0 1188.39             133 1188.39          133.01 1188.39 1186.89
     328 1188.39 1186.89  328.01 1188.39             368 1188.39

Downstream Bridge Cross Section Data
Station Elevation Data    num=     200
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 1184.58     .14 1184.58    2.63 1184.68    4.48 1184.75    11.6 1184.75
   16.19 1184.81   16.71 1184.83   19.58 1184.91   20.03 1184.92   22.34    1185
   29.75    1185   30.08 1184.98   31.58 1184.91   33.55 1184.85   34.38 1184.81
   36.03 1184.76   37.29 1184.73   39.33 1184.69   40.38 1184.65   41.15 1184.63
   42.57 1184.58   44.33  1184.5   46.47 1184.38   47.43 1184.33   49.92 1184.27
    50.4 1184.25   51.12 1184.19   52.08    1184   52.11  1183.5   52.15 1183.75
   53.31  1183.5   53.92 1183.54   56.88 1183.75   58.43 1183.75   60.84  1183.8
   62.15 1183.81    62.6 1183.82   63.94 1183.83   64.69 1183.83   66.05 1183.84
   66.46 1183.85   69.12 1183.87    70.2 1183.87   70.83 1183.88   72.21 1183.88
   72.62 1183.89   73.06 1183.88   75.04 1183.88   75.74 1183.87   76.62 1183.88
   77.38 1183.87   79.06 1183.87   85.24 1183.86   86.31 1183.87   87.55 1183.87
   89.57 1183.89   91.56 1183.89   91.72  1183.9   93.21  1183.9   93.54 1183.91
   94.75 1183.92   95.69 1183.92  100.38 1183.95  101.06 1183.96  102.04 1183.96
   105.3    1184  117.67    1184  125.01 1184.11  130.93 1184.19  135.64 1184.25
  138.92 1184.25  146.97 1184.25  150.02 1184.28  151.34 1184.28   151.8 1184.29
  156.42 1184.33  157.72 1184.33  162.71  1184.3  162.93 1184.29  164.31 1184.29
  165.89 1184.27  167.83 1184.26  168.21 1184.25  168.53 1184.26  169.36 1184.26
  170.49 1184.27  171.65 1184.29  171.82 1184.28  172.65 1184.29  175.74 1184.31
  176.06 1184.32   177.8 1184.33  178.76 1184.34  179.57 1184.34  181.51 1184.37
  182.66 1184.38  186.65 1184.39  188.01 1184.39  201.07 1184.43  201.52 1184.43
  202.88 1184.46  203.88 1184.47  203.91 1184.48  217.23 1184.48   220.2 1184.44
  221.51 1184.43  222.78 1184.41  227.58 1184.36  228.57 1184.36     229 1184.35
  229.75 1184.35  230.26 1184.34  242.28 1184.34  246.49 1184.25  256.72 1184.25
  260.43 1184.29  262.22 1184.29   263.9  1184.3  270.23  1184.3  274.01 1184.31
     275 1184.32  276.12 1184.32  278.05 1184.34  278.94 1184.34  281.07 1184.36
  282.18 1184.36  283.13 1184.37  284.03 1184.37  286.73 1184.39  287.89 1184.39
   288.3  1184.4  289.13  1184.4   292.6 1184.43  294.25 1184.45  298.82 1184.49
  299.17 1184.49  301.26 1184.52  301.53 1184.53  305.29 1184.59   307.1 1184.61
  310.07 1184.66  311.87  1184.7  314.43 1184.75  316.09 1184.75  324.56 1184.96
  326.41    1185  329.26 1185.09   334.6 1185.25  340.85  1185.5  342.59 1185.62
  343.27 1185.65  343.85 1185.69  345.28 1185.75  349.95 1185.75  350.15  1185.5
   350.4 1185.25  350.44    1185   350.7 1184.97  352.28 1184.75  352.29    1185
  352.58  1185.5  352.66 1186.25  352.67 1185.75  352.69    1186  352.79 1186.03
  353.06  1186.3  353.55 1186.35  355.11 1186.47  356.36 1186.56  357.65 1186.66
  358.22 1186.71   359.7 1186.82  359.88 1186.84   360.6 1186.88  361.15 1186.93
  362.15 1186.97  362.55    1187  363.49 1187.05  364.56 1187.09  364.81 1187.09
  365.94 1187.14  366.13 1187.14  367.36 1187.19   368.6 1187.27  369.33 1187.35
   370.6  1187.5  371.11 1187.59  372.11 1187.74  372.42 1187.75   373.4 1187.88
  374.24 1187.92  374.68    1188  375.89    1188  375.97 1188.08  376.02 1188.25
  376.26 1188.39   376.9  1188.5  377.15  1188.5  377.29 1188.53  378.11 1188.58

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
```

```
       0     .03  201.07     .03  345.28     .03

Bank Sta: Left   Right    Coeff Contr.   Expan.
        201.07  345.28             .3       .5
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
       0  133.94    1187       F
Right Levee     Station=  349.95      Elevation= 1185.75
Blocked Obstructions     num=       1
   Sta L   Sta R    Elev
     107     134    1187

Upstream Embankment side slope              =       2 horiz. to 1.0 vertical
Downstream Embankment side slope            =       2 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .98
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Abutments =  2

Abutment Data
Upstream     num=       2
     Sta    Elev     Sta    Elev
     135 1186.89     151 1178.75
Downstream     num=       2
     Sta    Elev     Sta    Elev
     133 1186.89     149 1178.75

Abutment Data
Upstream     num=       2
     Sta    Elev     Sta    Elev
     314 1178.75     330 1186.89
Downstream     num=       2
     Sta    Elev     Sta    Elev
     312 1178.75     328 1186.89

Number of Piers =  12

Pier Data
Pier Station     Upstream=     150    Downstream=     148
Upstream     num=       2
    Width   Elev    Width   Elev
     1.5 1182.39     1.5 1186.89
Downstream     num=       2
    Width   Elev    Width   Elev
     1.5 1182.39     1.5 1186.89

Pier Data
Pier Station     Upstream=     165    Downstream=     163
Upstream     num=       2
    Width   Elev    Width   Elev
     1.5 1182.39     1.5 1186.89
Downstream     num=       2
    Width   Elev    Width   Elev
     1.5 1182.39     1.5 1186.89

Pier Data
Pier Station     Upstream=     180    Downstream=     178
Upstream     num=       2
    Width   Elev    Width   Elev
     1.5 1182.39     1.5 1186.89
```

```
Downstream     num=       2
    Width   Elev    Width   Elev
     1.5 1182.39     1.5 1186.89

Pier Data
Pier Station     Upstream=     195    Downstream=     193
Upstream     num=       2
    Width   Elev    Width   Elev
     1.5 1182.39     1.5 1186.89
Downstream     num=       2
    Width   Elev    Width   Elev
     1.5 1182.39     1.5 1186.89

Pier Data
Pier Station     Upstream=     210    Downstream=     208
Upstream     num=       2
    Width   Elev    Width   Elev
     1.5 1182.39     1.5 1186.89
Downstream     num=       2
    Width   Elev    Width   Elev
     1.5 1182.39     1.5 1186.89

Pier Data
Pier Station     Upstream=     225    Downstream=     223
Upstream     num=       2
    Width   Elev    Width   Elev
     1.5 1182.39     1.5 1186.89
Downstream     num=       2
    Width   Elev    Width   Elev
     1.5 1182.39     1.5 1186.89

Pier Data
Pier Station     Upstream=     240    Downstream=     238
Upstream     num=       2
    Width   Elev    Width   Elev
     1.5 1182.39     1.5 1186.89
Downstream     num=       2
    Width   Elev    Width   Elev
     1.5 1182.39     1.5 1186.89

Pier Data
Pier Station     Upstream=     255    Downstream=     253
Upstream     num=       2
    Width   Elev    Width   Elev
     1.5 1182.39     1.5 1186.89
Downstream     num=       2
    Width   Elev    Width   Elev
     1.5 1182.39     1.5 1186.89

Pier Data
Pier Station     Upstream=     270    Downstream=     268
Upstream     num=       2
    Width   Elev    Width   Elev
     1.5 1182.39     1.5 1186.89
Downstream     num=       2
    Width   Elev    Width   Elev
     1.5 1182.39     1.5 1186.89

Pier Data
Pier Station     Upstream=     285    Downstream=     283
Upstream     num=       2
    Width   Elev    Width   Elev
     1.5 1182.39     1.5 1186.89
```

```
Downstream     num=       2
    Width   Elev    Width   Elev
     1.5 1182.39     1.5 1186.89

Pier Data
Pier Station     Upstream=     300    Downstream=     298
Upstream     num=       2
    Width   Elev    Width   Elev
     1.5 1182.39     1.5 1186.89
Downstream     num=       2
    Width   Elev    Width   Elev
     1.5 1182.39     1.5 1186.89

Pier Data
Pier Station     Upstream=     315    Downstream=     313
Upstream     num=       2
    Width   Elev    Width   Elev
     1.5 1182.39     1.5 1186.89
Downstream     num=       2
    Width   Elev    Width   Elev
     1.5 1182.39     1.5 1186.89

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
       W.S. Pro Method

  W.S.Pro Data
    Left Embankment
       El of the top of the embankment = 1188.39
       El of the toe of the abutment   = 1175
    Right Embankment
       El of the top of the embankment = 1188.39
       El of the toe of the abutment   = 1179
    Abtument Type                      = 3 Sloping abutments and sloping embankments
    Slope of abutments                 = 2
    Top with of embankment             = 12
    Centroid station of bridge opening =
    Wing Wall Type                     = No wing walls present
       Width                           =
       Angle                           =
       Radius                          =
    Guide Banks Type                   = Elliptical
       Length                          = 70
       Offset                          = 70
       Angle                           = 70

Selected Low Flow Methods = W.S.Pro Method

High Flow Method
       Energy Only

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

BRIDGE OUTPUT  Profile #PF 1
```

E.G. US. (m)	1186.34	Element	Inside BR US	Inside BR DS
W.S. US. (m)	1186.06	E.G. Elev (m)	1186.33	1186.16
Q Total (m3/s)	680.00	W.S. Elev (m)	1185.75	1185.58
Q Bridge (m3/s)	680.00	Crit W.S. (m)	1185.75	1185.58
Q Weir (m3/s)		Max Chl Dpth (m)	1.50	1.33
Weir Sta Lft (m)		Vel Total (m/s)	3.37	3.37
Weir Sta Rgt (m)		Flow Area (m2)	201.63	201.56
Weir Submerg		Froude # Chl	0.88	0.93
Weir Max Depth (m)		Specif Force (m3)	354.25	354.78
Min El Weir Flow (m)	1188.39	Hydr Depth (m)	1.17	1.17
Min El Prs (m)	1186.89	W.P. Total (m)	201.51	201.08
Delta EG (m)	0.32	Conv. Total (m3/s)	6735.5	6735.2
Delta WS (m)	0.31	Top Width (m)	172.51	171.87
BR Open Area (m2)	401.43	Frctn Loss (m)	0.09	0.02
BR Open Vel (m/s)	3.37	C & E Loss (m)	0.00	0.00
Coef of Q	1.00	Shear Total (N/m2)	100.01	100.20
Br Sel Method	WSPRO	Power Total (N/m s)	0.00	0.00

Warning: The flow regime calculated by the momentum equation shows class B flow. For the best solution, this profile should be
run as a mixed flow problem.
Warning: Pier drag coefficient of 2.0 assumed for Class B flow.
Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth
for the water surface and continued on with the calculations.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program
defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth
for the water surface and continued on with the calculations.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program
defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION

RIVER: Khowst
REACH: Reach1 RS: 229.1

INPUT
Description:
Station Elevation Data num= 200

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1184.58	.14	1184.58	2.63	1184.68	4.48	1184.75	11.6	1184.75
16.19	1184.81	16.71	1184.83	19.58	1184.91	20.03	1184.92	22.34	1185
29.75	1185	30.08	1184.98	31.58	1184.91	33.55	1184.85	34.38	1184.81
36.03	1184.76	37.29	1184.73	39.33	1184.69	40.38	1184.65	41.15	1184.63
42.57	1184.58	44.33	1184.5	46.47	1184.38	47.43	1184.33	49.92	1184.27
50.4	1184.25	51.12	1184.19	52.08	1184	52.11	1183.5	52.15	1183.75
53.31	1183.5	53.92	1183.54	56.88	1183.75	58.43	1183.75	60.84	1183.8
62.15	1183.81	62.6	1183.82	63.94	1183.83	64.69	1183.83	66.05	1183.84
66.46	1183.85	69.12	1183.87	70.2	1183.87	70.83	1183.88	72.21	1183.88
72.62	1183.89	73.06	1183.88	75.04	1183.88	75.74	1183.87	76.62	1183.88
77.38	1183.87	79.06	1183.87	85.24	1183.86	86.31	1183.87	87.55	1183.87
89.57	1183.89	91.56	1183.89	91.72	1183.9	93.21	1183.9	93.54	1183.91
94.75	1183.92	95.69	1183.92	100.38	1183.95	101.06	1183.96	102.04	1183.96
105.3	1184	117.67	1184	125.01	1184.11	130.93	1184.19	135.64	1184.25
138.92	1184.25	146.97	1184.25	150.02	1184.28	151.34	1184.28	151.8	1184.29
156.42	1184.33	157.72	1184.33	162.71	1184.3	162.93	1184.29	164.31	1184.29
165.89	1184.27	167.83	1184.26	168.21	1184.25	168.53	1184.26	169.36	1184.26
170.49	1184.27	171.65	1184.29	171.82	1184.28	172.65	1184.29	175.74	1184.31
176.06	1184.32	177.8	1184.33	178.76	1184.34	179.57	1184.34	181.51	1184.37
182.66	1184.38	186.65	1184.39	188.01	1184.39	201.07	1184.43	201.52	1184.43
202.88	1184.46	203.88	1184.47	203.91	1184.48	217.23	1184.48	220.2	1184.44
221.51	1184.43	222.78	1184.41	227.58	1184.36	228.57	1184.36	229	1184.35
229.75	1184.35	230.26	1184.34	242.28	1184.34	246.49	1184.25	256.72	1184.25
260.43	1184.29	262.22	1184.29	263.9	1184.3	270.23	1184.3	274.01	1184.31
275	1184.32	276.12	1184.32	278.05	1184.34	278.94	1184.34	281.07	1184.36
282.18	1184.36	283.13	1184.37	284.03	1184.37	286.73	1184.39	287.89	1184.39
288.3	1184.4	289.13	1184.4	292.6	1184.43	294.25	1184.45	298.82	1184.49
299.17	1184.49	301.26	1184.52	301.53	1184.53	305.29	1184.59	307.1	1184.61
310.07	1184.66	311.87	1184.7	314.43	1184.75	316.09	1184.75	324.56	1184.96
326.41	1185	329.26	1185.09	334.6	1185.25	340.85	1185.5	342.59	1185.62
343.27	1185.65	343.85	1185.69	345.28	1185.75	349.95	1185.75	350.15	1185.5
350.4	1185.25	350.44	1185	350.7	1184.97	352.28	1184.75	352.29	1185
352.58	1185.5	352.66	1186.25	352.67	1185.75	352.69	1186	352.79	1186.03
353.06	1186.3	353.55	1186.35	355.11	1186.47	356.36	1186.56	357.65	1186.66
358.22	1186.71	359.7	1186.82	359.88	1186.84	360.6	1186.88	361.15	1186.93
362.15	1186.97	362.55	1187	363.49	1187.05	364.56	1187.09	364.81	1187.09
365.94	1187.14	366.13	1187.14	367.36	1187.19	368.6	1187.27	369.33	1187.35
370.6	1187.5	371.11	1187.59	372.11	1187.74	372.42	1187.75	373.4	1187.88
374.24	1187.92	374.68	1188	375.89	1188	375.97	1188.08	376.02	1188.25
376.26	1188.39	376.9	1188.5	377.15	1188.5	377.29	1188.53	378.11	1188.58

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	201.07	.03	345.28	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
201.07	345.28	11.25	11.51	11.76	.3	.5

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
0	133.94	1187	F

Right Levee Station= 349.95 Elevation= 1185.75
Blocked Obstructions num= 1

Sta L	Sta R	Elev
107	134	1187

CROSS SECTION

RIVER: Khowst
REACH: Reach1 RS: 217.5

INPUT
Description:
Station Elevation Data num= 200

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1184.65	1.38	1184.65	7.75	1184.74	8.1	1184.75	31.25	1184.75
32.96	1184.66	33.98	1184.62	35.7	1184.57	36.07	1184.55	38.38	1184.5
45.11	1184.5	47.62	1184.36	49.16	1184.25	49.81	1184.25	54.39	1184
57.97	1183.83	59.54	1183.75	64.07	1183.6	65.2	1183.57	67.38	1183.5
74.2	1183.5	74.69	1183.48	75.95	1183.48	78.48	1183.5	80.13	1183.54
82.81	1183.59	83.52	1183.59	84.64	1183.62	87.09	1183.64	87.14	1183.65
88.48	1183.66	89.87	1183.71	91.26	1183.72	93.1	1183.72	93.35	1183.73
94.78	1183.73	96.13	1183.75	97.34	1183.75	98.98	1183.76	100.69	1183.76
102.14	1183.77	103.39	1183.77	107.87	1183.82	108.14	1183.82	115.93	1183.91
117.22	1183.91	118.97	1183.93	121.67	1183.97	122.84	1184	131.87	1184
133.13	1184.02	134.46	1184.02	135.47	1184.01	159.79	1184.01	161.52	1184
166.33	1184	172.65	1184	172.82	1183.99	180.82	1183.95	182.09	1183.96
183.03	1183.98	183.69	1183.98	184.98	1184.02	185.33	1184.02	185.6	1184.13
186.84	1184.15	188.37	1184.16	190.28	1184.18	191.73	1184.21	193.03	1184.21
193.74	1184.2	195.18	1184.2	197.85	1184.18	199.84	1184.18	200.72	1184.17
204.95	1184.17	205.06	1184.18	224.46	1184.18	225.28	1184.19	229.03	1184.19
229.71	1184.2	231.2	1184.2	235.57	1184.23	237.03	1184.23	238.42	1184.24
239.39	1184.21	240.31	1184.2	241.41	1184.17	243.57	1184.16	248.09	1184.07
254.11	1184.07	254.22	1184.06	258.04	1184.06	259.02	1184.05	264.77	1184.05
266.47	1184.04	270.78	1184.04	272.3	1184.03	277.81	1184.03	280.03	1184.04
281.04	1184.05	282.83	1184.05	283.04	1184.06	284.66	1184.07	286.74	1184.07
287.38	1184.08	288.67	1184.08	290.36	1184.1	291.35	1184.16	291.84	1184.16
292.84	1184.25	295.43	1184.25	299.82	1184.27	299.99	1184.28	301.31	1184.28
302.06	1184.29	303.37	1184.29	304.28	1184.33	305.5	1184.32	305.78	1184.34
306.37	1184.34	306.72	1184.37	307.2	1184.37	307.84	1184.44	308.04	1184.44
308.48	1184.5	315.43	1184.5	317.17	1184.53	317.25	1184.54	318.71	1184.54
318.88	1184.55	320.05	1184.55	320.44	1184.58	321.39	1184.57	322.34	1184.75
326.3	1184.75	327.3	1184.78	330.11	1184.78	331.44	1184.77	332.14	1184.79
332.99	1184.79	333.37	1184.82	333.77	1185	336.28	1185	336.58	1184.84
336.59	1184.96	336.81	1184.75	337.17	1184.99	337.33	1185.25	337.55	1185.16
337.61	1184.71	338.15	1184.69	339.94	1184.68	340.74	1184.69	341.55	1184.72
342.28	1184.78	343.13	1184.87	343.48	1184.92	343.49	1185.09	343.62	1185.15
343.68	1184.95	344.17	1185	344.28	1185.11	344.54	1185.18	344.88	1185.16
345.4	1185.22	346.71	1185.06	346.99	1185	348.88	1185	349.95	1185.23
350.29	1185.25	352.14	1185.25	352.8	1185.4	354.52	1185.5	355.9	1185.5
356.39	1185.6	358.35	1185.7	358.77	1185.69	359.19	1185.49	359.61	1185.25
359.93	1185.25	360.1	1185.5	361.13	1185.5	361.75	1185.56	362.59	1185.54
364.2	1185.62	364.62	1185.63	367.36	1185.75	369.43	1185.87	369.96	1185.91
371.05	1185.97	371.79	1186	374.12	1186.11	374.76	1186.13	380.45	1186.38
381.14	1186.4	382.3	1186.45	382.64	1186.45	383.66	1186.5	384.56	1186.46

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	235.57	.03	358.35	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
235.57	358.35	14.15	14.53	14.91	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
0	132	1185.97	F

Right Levee Station= 358.72 Elevation= 1185.7

CROSS SECTION

RIVER: Khowst
REACH: Reach1 RS: 203.0

INPUT
Description:
Station Elevation Data num= 200

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1184.75	9.6	1184.75	9.98	1184.72	11.75	1184.6	13	1184.54
14.11	1184.5	14.62	1184.5	14.98	1184.55	16.7	1184.75	35.81	1184.75
36.85	1184.38	37.27	1184.22	37.61	1184	41.24	1184	41.5	1184.02
41.92	1184.09	42.27	1184.08	42.67	1184.12	43.09	1184.11	43.76	1184.15
44.24	1184.14	44.46	1184.15	52.47	1184.15	52.6	1184.14	53.31	1184.14
53.41	1184.13	54.26	1184.13	54.32	1184.12	55.46	1184.12	56.01	1184.11
58.21	1184.1	58.85	1184	61.76	1184	62.6	1183.84	63.13	1183.75
63.59	1183.69	63.87	1183.68	66.19	1183.5	66.5	1183.5	69.02	1183.39
72.47	1183.25	73.44	1183.19	75.12	1183.13	77.06	1183.04	77.83	1183.01
79.73	1182.98	79.96	1182.98	82.65	1182.94	85.35	1182.89	87.49	1182.86
89.08	1182.83	89.94	1182.83	90.71	1182.81	93.09	1182.81	96.18	1182.84
100.11	1182.88	100.86	1182.88	101.88	1182.9	102.72	1182.91	103.9	1182.94
104.23	1182.94	106.25	1182.98	108.12	1183.01	110.01	1183.03	112.63	1183.05
114.78	1183.1	115.65	1183.11	116.94	1183.19	117.32	1183.19	118.05	1183.25
119.61	1183.35	121.31	1183.45	121.67	1183.45	121.99	1183.47	122.51	1183.48
128.89	1183.48	129.97	1183.49	130.89	1183.49	132.03	1183.51	133.41	1183.52
134.56	1183.54	135.48	1183.55	135.79	1183.56	136.5	1183.56	137.95	1183.58
139.18	1183.6	140.41	1183.61	141.62	1183.63	143.42	1183.64	144.9	1183.66
146.46	1183.66	148.04	1183.67	148.4	1183.68	149.97	1183.68	151.05	1183.69
152.51	1183.69	155.33	1183.74	155.77	1183.75	167.13	1183.75	167.89	1183.73
170.19	1183.66	173.53	1183.55	175.21	1183.5	179.08	1183.5	181.05	1183.55
181.55	1183.57	183.62	1183.62	186.44	1183.7	187.93	1183.75	200.73	1183.75
200.77	1183.5	202.47	1183.5	204.22	1183.55	205.14	1183.57	209.35	1183.53
210.35	1183.5	219.23	1183.5	222.65	1183.48	223.31	1183.5	229.51	1183.5
231.03	1183.47	231.28	1183.46	232.66	1183.43	233.68	1183.39	234.59	1183.37
235.8	1183.31	236.13	1183.3	237.17	1183.25	239.37	1183.18	241.77	1183.09
243.39	1183.04	244.46	1183	248.75	1182.9	250.81	1182.85	255.15	1182.74
255.39	1182.73	257.69	1182.67	259.49	1182.62	260.96	1182.57	265.45	1182.45
265.68	1182.44	268.21	1182.37	268.33	1182.36	272.03	1182.34	273.36	1182.42
274.69	1182.52	277.39	1182.73	279.67	1182.92	281.14	1183.06	283.3	1183.25
306.76	1183.25	307.81	1183.27	320.16	1183.36	321.3	1183.34	321.91	1183.32
322.52	1183.31	325.11	1183.25	325.77	1183.23	327.39	1183.19	331.09	1183.11
332.25	1183.08	333.36	1183.06	335.66	1183.01	335.7	1183	342.83	1183
343.19	1183.97	343.27	1184.25	343.32	1184.57	343.36	1185	344.91	1185
344.98	1184.75	345.17	1184.25	345.33	1183.5	345.34	1183.25	346.99	1183.25
347.95	1183.3	348.31	1183.31	351.03	1183.44	353	1183.52	354.55	1183.59
355.18	1183.61	356.06	1183.65	357.87	1183.72	358.1	1183.72	358.68	1183.75
359.33	1183.76	360.2	1183.79	361.33	1183.81	362.5	1183.84	363	1183.86
363.72	1183.87	364.94	1183.91	365.59	1183.92	368.04	1184	368.51	1184.07
369.03	1184.25	369.11	1184.5	369.15	1184.75	370.36	1185	384.03	1185

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	200.73	.03	343.36	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
200.73	343.36	12.91	13.19	13.47	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
0	131	1184.89	F

Right Levee Station= 343.45 Elevation= 1185

CROSS SECTION

RIVER: Khowst
REACH: Reach1 RS: 189.8

INPUT
Description:
Station Elevation Data num= 200

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1184.5	6.09	1184.5	6.99	1184.3	8.39	1184	9.64	1184
10.07	1184.06	10.96	1184	12.09	1183.97	13.61	1183.9	14.42	1183.87
16.15	1183.84	18.66	1183.79	20.9	1183.75	24.17	1183.75	25.19	1183.79
25.3	1183.78	26.05	1183.81	26.27	1183.8	26.97	1183.82	28.37	1183.83
28.92	1183.84	39.51	1184	65.84	1184	67.74	1183.75	69.15	1183.6
70.13	1183.5	71.01	1183.4	72.03	1183.34	72.54	1183.3	73.58	1183.25
76.26	1183.19	76.8	1183.17	78.17	1183.14	78.85	1183.11	79.61	1183.09
81.51	1183	82.91	1182.83	84.22	1182.75	85.37	1182.74	88.12	1182.69
90.25	1182.66	91.42	1182.63	92.78	1182.61	94.53	1182.58	95.4	1182.56
97.38	1182.53	98.82	1182.5	102.59	1182.5	105.37	1182.56	106.11	1182.57
107.25	1182.6	109.08	1182.63	110.21	1182.66	111.82	1182.69	112.62	1182.71
114.76	1182.75	116.5	1182.82	117.37	1182.85	117.96	1182.88	120.26	1182.97
120.91	1183	124.07	1183.25	125.28	1183.34	127.58	1183.5	129.35	1183.56
130.1	1183.57	131.63	1183.6	132.44	1183.6	133.47	1183.62	136.3	1183.65
137.57	1183.66	138.21	1183.67	140.71	1183.69	142.47	1183.7	148.12	1183.75
159.37	1183.75	160.42	1183.74	161.05	1183.74	161.87	1183.73	162.87	1183.73
163.02	1183.72	163.87	1183.72	165.14	1183.7	165.71	1183.7	166.8	1183.68
167.37	1183.66	168.45	1183.64	169.29	1183.61	171.8	1183.54	172.45	1183.53
173.41	1183.5	178.72	1183.5	180.02	1183.54	181.37	1183.57	184.39	1183.66
187.73	1183.75	200.37	1183.75	200.54	1183.5	200.65	1183.25	214.33	1183.25
215.17	1183.27	216.82	1183.27	217.13	1183.28	219.37	1183.28	223.26	1183.25
226.97	1183.25	231.35	1183.12	232.07	1183.11	233.47	1183.07	236.77	1183
237	1183	239.37	1182.94	239.8	1182.94	240.4	1182.92	241.5	1182.9
242.31	1182.88	243.55	1182.86	244.34	1182.84	245.87	1182.81	246.1	1182.8
247.24	1182.78	250.93	1182.69	252.3	1182.66	253.09	1182.65	254.14	1182.62
255.98	1182.59	257.79	1182.55	259.35	1182.53	259.63	1182.52	260.93	1182.5
261.95	1182.47	264.72	1182.4	268.17	1182.3	269.68	1182.25	273.94	1182.25
276.33	1182.4	277.82	1182.5	281.74	1182.75	282.73	1182.84	284.61	1183
289.96	1183.14	291.18	1183.15	291.58	1183.16	297.22	1183.25	303.57	1183.25
312.06	1183.46	313.55	1183.5	321.06	1183.5	324.98	1183.25	327.76	1183.07
332.62	1182.77	332.86	1182.75	336.03	1182.9	336.35	1182.92	338.1	1183
338.14	1182.75	338.15	1183.25	338.3	1184.13	338.42	1184.5	338.48	1184.75
340.36	1184.75	340.39	1183.69	340.42	1184.5	340.48	1184.25	340.57	1184
340.69	1183.75	341.2	1183.7	341.47	1183.7	342.31	1183.65	342.91	1183.65
343.34	1183.64	344.07	1183.64	344.95	1183.61	346.73	1183.42	347.81	1183.41
351.44	1183.41	353.62	1183.43	354.58	1183.45	355.89	1183.46	356.1	1183.47
357.34	1183.48	358.37	1183.5	359.26	1183.51	360.26	1183.53	361.29	1183.54
362.57	1183.57	363.43	1183.58	364.26	1183.6	365.03	1183.61	366.5	1183.64
368.26	1183.69	369.91	1183.92	370.03	1183.95	370.07	1183.75	370.09	1184.25
370.22	1184.75	372.41	1184.84	374.26	1184.92	375.99	1185	380.83	1185.15

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	200.37	.03	338.48	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
200.37	338.48	10.85	11.58	12.32	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
0	125	1185.18	F

Right Levee Station= 340.07 Elevation= 1184.76

CROSS SECTION

RIVER: Khowst
REACH: Reach1 RS: 178.2

INPUT
Description:
Station Elevation Data num= 200

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1183.77	.06	1183.75	.58	1183.55	.7	1183.5	3.67	1183.5
3.84	1183.54	3.89	1183.54	4.02	1183.56	4.11	1183.55	4.2	1183.55
4.29	1183.54	4.37	1183.54	5.6	1183.53	17.24	1183.71	21.42	1183.71
34.36	1183.75	41	1183.75	42.41	1183.78	42.78	1183.78	45.57	1183.83
45.85	1183.84	46.19	1183.84	46.96	1183.85	48.81	1183.89	50.84	1183.92
51.76	1183.94	52.28	1183.95	53.78	1183.96	56.06	1184	62.85	1184
63.96	1183.99	64.35	1184	70.64	1184	71	1183.99	71.75	1183.98
71.83	1183.98	72.82	1183.97	72.95	1183.97	74.01	1183.96	75.04	1183.92
75.73	1183.88	76.54	1183.87	77.98	1183.75	78.11	1183.74	80.56	1183.5
82.14	1183.35	83.14	1183.25	85.24	1183.18	91	1183	91.73	1182.89
92.72	1182.75	93.23	1182.68	93.42	1182.67	94.11	1182.59	94.65	1182.57
94.89	1182.55	96.1	1182.52	96.2	1182.51	96.94	1182.5	98.37	1182.5
99.54	1182.49	101.15	1182.48	102.59	1182.47	102.66	1182.47	103.85	1182.46
104.75	1182.46	105.26	1182.45	105.71	1182.45	117.12	1182.44	118.7	1182.47
120.32	1182.49	120.96	1182.5	121.12	1182.5	122.29	1182.53	122.82	1182.55
124.34	1182.59	125.65	1182.63	128.41	1182.71	129.72	1182.75	129.82	1182.75
135.77	1183	135.87	1183	137.79	1183.08	139.98	1183.12	143.91	1183.21
144.58	1183.23	145.45	1183.25	147.31	1183.3	147.65	1183.3	148.56	1183.32
150.71	1183.37	151.27	1183.39	151.88	1183.4	152.32	1183.41	153.42	1183.44
153.78	1183.44	154.45	1183.45	154.98	1183.46	156.64	1183.48	157.25	1183.49
158.02	1183.49	158.04	1183.5	158.12	1183.5	158.23	1183.49	158.25	1183.5
158.53	1183.49	159.07	1183.49	161.52	1183.5	190.97	1183.5	197.17	1183.66
198.61	1183.7	200.36	1183.75	204.24	1183.75	204.3	1183.64	204.37	1183.5
204.44	1183.38	204.55	1183.15	204.61	1183	219.21	1183	220.1	1183.01
223.76	1183.01	225.03	1183.02	228.52	1183.02	232.48	1183	235.63	1183
236.19	1182.99	236.43	1182.98	238.72	1182.92	240.28	1182.87	241.65	1182.83
241.79	1182.83	243.28	1182.78	243.62	1182.77	243.8	1182.77	244.4	1182.75
250.67	1182.64	259.68	1182.5	262.9	1182.44	263.75	1182.43	266.9	1182.38
268.91	1182.35	272.59	1182.3	273.57	1182.28	275.91	1182.25	282.05	1182.25
285.01	1182.39	286.02	1182.43	287.37	1182.5	288.78	1182.59	290.58	1182.7
291.43	1182.75	295.65	1182.97	296.2	1183	302.28	1183.16	305.48	1183.25
305.85	1183.25	309.89	1183.34	311.28	1183.36	312.41	1183.39	313.49	1183.41
315.36	1183.44	315.91	1183.45	318.09	1183.5	330.51	1183.5	331.81	1183.33
333.1	1183.15	334.21	1183	334.99	1182.93	337.53	1182.75	338.41	1182.75
338.42	1182.91	338.44	1183.09	338.45	1183.22	338.46	1183.25	338.47	1183.41
338.48	1183.5	338.51	1183.9	338.52	1184	338.54	1184.48	338.56	1184.61
338.59	1184.75	340.54	1184.75	340.59	1184.58	340.68	1184.32	340.84	1183.75
341.82	1183.75	342.51	1183.79	344.53	1183.9	346.26	1184	347	1184.04
348.26	1184.11	349.91	1184.21	350.69	1184.25	352.93	1184.38	355.34	1184.51
357.72	1184.59	358.39	1184.58	359.18	1184.57	359.44	1184.57	360.23	1184.56

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	200.36	.03	338.59	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
200.36	338.59	18.59	19.58	20.56	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
0	129	1184.88	F

Right Levee Station= 340.33 Elevation= 1184.77

CROSS SECTION

RIVER: Khowst
REACH: Reach1 RS: 158.7

INPUT
Description:
Station Elevation Data num= 200

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1183.46	1.14	1183.47	2.66	1183.5	11.44	1183.5	15.8	1183.57
25.17	1183.58	25.94	1183.58	34.97	1183.6	36.7	1183.62	40.32	1183.63
52.41	1183.75	62.4	1183.75	65.29	1183.69	65.78	1183.7	66.41	1183.69
66.77	1183.67	68.7	1183.6	69.08	1183.58	70	1183.56	71.32	1183.52
71.46	1183.51	74.14	1183.48	75.42	1183.48	76.84	1183.47	79.2	1183.45
79.6	1183.44	80.98	1183.43	81.58	1183.41	82.74	1183.4	83.53	1183.37
84.35	1183.36	85.29	1183.32	85.7	1183.32	86.64	1183.27	89.13	1183.15
92.01	1183	94.16	1182.88	96.31	1182.75	96.73	1182.66	98.8	1182.25
105.87	1182.25	108.11	1182.23	110.81	1182.23	114.1	1182.25	119.19	1182.25
121.33	1182.31	123.2	1182.36	123.85	1182.38	125.47	1182.42	126.53	1182.45
128.61	1182.5	130.67	1182.57	133.81	1182.68	134.48	1182.7	141.37	1182.98
141.74	1183	142	1183	146.43	1183.05	147.69	1183.07	148.25	1183.07
151.35	1183.1	151.69	1183.11	155.26	1183.14	155.62	1183.14	156.55	1183.15
168.05	1183.23	168.46	1183.23	171.21	1183.26	173.3	1183.29	173.73	1183.3
175.24	1183.32	176.99	1183.34	177.94	1183.35	178.18	1183.36	179.71	1183.37
181.77	1183.4	182.41	1183.4	182.87	1183.41	184.3	1183.42	184.48	1183.43
186.18	1183.44	186.68	1183.45	187.15	1183.45	187.29	1183.46	188.12	1183.46
188.93	1183.47	190.95	1183.47	191.33	1183.49	191.36	1183.48	191.79	1183.5
197.3	1183.5	197.94	1183	198.1	1182.75	208.82	1182.75	209.31	1182.76
211.75	1182.8	212.6	1182.81	213.81	1182.82	214.12	1182.83	215.24	1182.84
216.82	1182.86	217.15	1182.86	218.24	1182.88	222.81	1182.88	224.33	1182.86
224.4	1182.85	225.73	1182.84	226.01	1182.83	228.22	1182.8	230.86	1182.77
232.17	1182.75	232.4	1182.75	236.06	1182.7	236.69	1182.69	237.21	1182.69
238.8	1182.67	239.52	1182.65	240.31	1182.64	241.28	1182.62	241.9	1182.62
244.03	1182.57	244.23	1182.57	247.38	1182.5	247.47	1182.5	251.17	1182.43
251.56	1182.42	253.7	1182.38	254.94	1182.35	258.48	1182.32	259.17	1182.3
260.63	1182.29	262.25	1182.27	263.42	1182.25	264.2	1182.21	266.3	1182.08
267.78	1182	268.03	1181.99	269.17	1181.92	269.34	1181.92	270.28	1181.89
270.72	1181.87	271.59	1181.86	271.95	1181.86	272.28	1181.85	273.47	1181.85
273.78	1181.86	274.34	1181.85	274.79	1181.87	275.49	1181.86	276.07	1181.89
276.29	1181.89	277.43	1181.94	278.66	1182	285.19	1182	285.51	1182.1
285.92	1182.15	286.84	1182.33	288.85	1182.5	288.94	1182.38	289.08	1182.25
289.1	1182.75	289.21	1182.83	289.34	1182.99	289.82	1183.5	289.93	1183.75
290.02	1184.18	290.06	1184.5	290.18	1184.5	290.24	1184.25	290.34	1184
291.4	1184	291.43	1184.21	291.49	1184.75	291.59	1185	292.1	1185.43
292.35	1185.59	293.01	1185.93	293.76	1186.33	294	1186.54	295.02	1187.5
296	1187.62	296.51	1187.71	296.92	1187.82	297.25	1187.85	297.58	1187.9
298	1187.95	298.65	1187.97	299	1188	299.53	1188	300.05	1188.2
300.74	1188.25	301.37	1188.39	301.89	1188.5	303.31	1188.59	303.45	1188.62
304.19	1188.75	304.81	1188.77	306.41	1188.8	310.2	1188.86	310.42	1188.85

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	197.3	.03	290.06	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
197.3	290.06	17.86	18.82	19.79	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
0	123	1187.47	F

Right Levee Station= 290.13 Elevation= 1184.51

CROSS SECTION

RIVER: Khowst

REACH: Reach1 RS: 139.8

INPUT
Description:
Station Elevation Data num= 200

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1183.25	1.25	1183.25	1.83	1183.26	1.96	1183.27	5.43	1183.34
6.13	1183.35	6.73	1183.37	10.12	1183.44	10.37	1183.44	11.91	1183.46
12.42	1183.46	12.96	1183.45	14.25	1183.48	15.33	1183.48	16.57	1183.5
27.83	1183.5	31.57	1183.53	31.81	1183.53	35.02	1183.56	35.49	1183.57
36.13	1183.57	43.31	1183.63	44.38	1183.65	44.73	1183.65	49.04	1183.67
49.68	1183.69	50.42	1183.69	52.7	1183.53	54.13	1183.5	59.19	1183.5
60.12	1183.47	60.18	1183.46	62.42	1183.36	63.13	1183.32	64.56	1183.25
65.49	1183.21	65.81	1183.21	67.07	1183.17	70.69	1183.11	73.98	1183.11
74.2	1183.1	78.27	1183.06	79.67	1183.03	80.91	1183	81.16	1182.99
84.31	1182.92	85.76	1182.88	87.51	1182.84	90.15	1182.75	90.63	1182.51
91.12	1182.25	92.19	1182.22	92.46	1182.22	93.99	1182.18	94.79	1182.17
96.93	1182.12	97.86	1182.11	99.11	1182.08	100.47	1182.06	102.23	1182.04
102.8	1182.03	104.51	1182.01	105.71	1182	108.39	1182	109.03	1182
113.44	1182.07	116.1	1182.11	118.11	1182.15	118.37	1182.16	122.98	1182.25
123.61	1182.25	124.52	1182.28	126.07	1182.32	126.62	1182.34	127.28	1182.35
132.65	1182.5	134.72	1182.57	136.99	1182.65	138.14	1182.7	138.59	1182.71
139.69	1182.75	142.06	1182.84	142.53	1182.85	144.58	1182.93	145.43	1182.95
146.08	1182.97	146.81	1182.97	148.23	1182.98	148.32	1182.99	149.92	1182.99
151.3	1183	152.81	1183	153.62	1183.01	157.06	1183.01	157.08	1183.02
158.51	1183.02	162.53	1183.03	162.68	1183.04	164.56	1183.05	165.76	1183.06
166.18	1183.06	167.69	1183.07	168.29	1183.08	169.73	1183.09	170.73	1183.11
172.05	1183.11	172.59	1183.12	174.46	1183.14	175.64	1183.15	176.34	1183.16
176.81	1183.16	179.01	1183.12	179.19	1183.11	179.55	1183.12	180.1	1183.09
180.42	1183.1	181.03	1183.05	181.22	1183.06	181.81	1183	181.87	1182.75
185.37	1182.7	188.29	1182.65	189.72	1182.63	191.39	1182.6	192.84	1182.58
193.64	1182.56	194.06	1182.56	194.91	1182.54	195.49	1182.54	195.83	1182.53
197.79	1182.51	199.38	1182.51	200.57	1182.5	200.99	1182.5	202.47	1182.48
205.7	1182.46	207.39	1182.44	207.77	1182.44	209.87	1182.41	210.47	1182.39
211.1	1182.38	214.48	1182.37	215.74	1182.38	218.94	1182.39	219.39	1182.4
225.47	1182.39	228.38	1182.42	229.83	1182.42	231.23	1182.43	231.64	1182.43
233.51	1182.44	234.98	1182.45	236.68	1182.45	236.95	1182.46	238.14	1182.43
239.02	1182.43	239.64	1182.44	240.1	1182.41	240.59	1182.41	240.88	1182.42
244.23	1182.03	245.55	1181.89	246.3	1181.82	247.14	1181.75	248.72	1181.75
248.83	1182.68	248.86	1183	248.89	1183.16	248.97	1183.75	249.13	1184.5
249.15	1185	249.17	1184.91	249.21	1184.5	249.25	1184.25	249.39	1183.75
249.93	1183.75	249.95	1183.91	250.05	1184.5	250.09	1184.63	250.12	1185
250.2	1185.25	250.41	1185.5	250.82	1186.02	250.99	1186.25	251.08	1186.5
251.47	1188	251.49	1188.25	252.3	1188.29	253.17	1188.35	254.19	1188.4
255.62	1188.5	256.62	1188.62	257.6	1188.75	257.91	1188.77	260.57	1189
261.29	1189.05	264.56	1189.25	268.07	1189.47	268.58	1189.5	268.93	1189.53

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	172.05	.03	249.15	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
172.05	249.15	24.41	25.9	27.38	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
0	108	1186	F

Left Levee Station= 50.42 Elevation= 1183.69
Right Levee Station= 249.15 Elevation= 1185.01

CROSS SECTION

RIVER: Khowst

REACH: Reach1 RS: 113.9

INPUT
Description:
Station Elevation Data num= 200

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1183.32	2.6	1183.32	3.21	1183.31	4.11	1183.3	4.96	1183.29
6.38	1183.27	7.51	1183.25	8.12	1183.23	15.67	1183	16.49	1182.97
16.7	1182.97	16.8	1182.96	17	1182.96	17.36	1182.95	17.97	1182.93
20.21	1182.86	23.34	1182.75	23.78	1182.75	28.9	1182.63	29.86	1182.6
31.23	1182.57	31.38	1182.56	31.66	1182.56	33.2	1182.51	33.29	1182.51
33.72	1182.5	35.07	1182.44	35.76	1182.41	36.3	1182.39	38.59	1182.26
38.67	1182.26	38.8	1182.25	42.47	1182.1	44.86	1182	52.61	1182
60.69	1182	64.37	1182.1	68.59	1182.21	69.24	1182.23	69.4	1182.24
69.95	1182.25	70.55	1182.25	75.89	1182.31	77.01	1182.32	77.35	1182.32
78.19	1182.33	78.68	1182.34	79.34	1182.34	80.06	1182.35	81	1182.36
81.55	1182.37	87.21	1182.43	91.2	1182.48	91.49	1182.48	93.34	1182.5
95.53	1182.56	97	1182.6	99.14	1182.66	102.46	1182.74	102.62	1182.74
102.93	1182.75	107.7	1182.75	109.09	1182.69	109.81	1182.67	111.09	1182.61
112.78	1182.55	113.17	1182.54	114.14	1182.5	115.58	1182.45	116.93	1182.4
117.04	1182.4	117.57	1182.38	117.97	1182.37	118.15	1182.36	118.28	1182.36
118.55	1182.35	119.01	1182.34	119.83	1182.31	120.16	1182.3	121.58	1182.25
121.76	1182.25	124.03	1182.2	124.56	1182.19	126.52	1182.15	127.42	1182.14
128.83	1182.11	129.82	1182.09	130.71	1182.08	131.35	1182.07	131.69	1182.06
132.21	1182.05	132.34	1182.05	133.72	1182.04	133.93	1182.04	134.08	1182.05
134.89	1182.05	135.21	1182.06	135.55	1182.06	136.18	1182.07	137.07	1182.09
137.62	1182.09	138.59	1182.11	139.77	1182.11	140.81	1182.13	141.18	1182.13
142.09	1182.14	142.3	1182.14	143.05	1182.15	143.15	1182.15	143.75	1182.16
147.6	1182	154.42	1182.06	161.21	1182.12	161.38	1182.12	168.58	1182.25
170.26	1182.25	170.7	1182.25	171.53	1182.25	172.69	1182.25	173.75	1182.25
176.64	1182.25	176.64	1182.26	176.74	1182.39	176.82	1182.5	176.82	1182.51
177	1182.75	177.17	1182.99	177.18	1183	177.24	1183.09	177.36	1183.25
177.37	1183.26	177.55	1183.5	177.73	1183.75	177.83	1183.88	177.89	1183.96
177.92	1184	178.06	1184.19	178.11	1184.25	178.2	1184.35	178.32	1184.5
178.41	1184.6	178.54	1184.75	178.66	1184.89	178.75	1185	178.91	1185.18
178.97	1185.25	179.04	1185.25	179.13	1185.25	179.13	1185.22	179.14	1185
179.15	1184.99	179.15	1184.98	179.17	1184.75	179.18	1184.65	179.21	1184.5
179.23	1184.4	179.27	1184.25	179.29	1184.12	179.3	1184	179.32	1183.88
179.34	1183.75	179.86	1183.75	179.87	1183.75	179.88	1183.75	179.88	1183.77
179.89	1183.81	179.91	1184	179.92	1184.08	179.94	1184.25	179.96	1184.4
179.98	1184.5	180.01	1184.7	180.02	1184.75	180.06	1184.97	180.06	1185
180.06	1185.05	180.08	1185.25	180.1	1185.49	180.1	1185.5	180.11	1185.68
180.12	1185.75	180.17	1185.89	180.2	1186	180.37	1186.08	180.71	1186.25
180.87	1186.33	181.22	1186.5	181.63	1186.68	181.81	1186.75	182.4	1186.95
182.56	1187	182.67	1187.04	183.34	1187.25	183.83	1187.33	184.8	1187.5
186.43	1187.61	187.87	1187.71	188.52	1187.75	191.22	1187.88	191.9	1187.91

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	107.7	.03	178.97	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
107.7	178.97	26.6	28.2	30.23	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
0	47	1187	F

Right Levee Station= 179.04 Elevation= 1185.25

CROSS SECTION

RIVER: Khowst
REACH: Reach1 RS: 85.7

INPUT
Description:
Station Elevation Data num= 200

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1182.87	5.32	1182.78	5.36	1182.78	5.67	1182.75	6.48	1182.68
6.94	1182.67	7.67	1182.62	8.21	1182.59	9.5	1182.56	10.01	1182.54
11.49	1182.5	11.77	1182.5	12.13	1182.49	12.64	1182.49	19.68	1182.44
19.87	1182.43	20.08	1182.43	20.51	1182.42	21.26	1182.41	22.35	1182.4
25.28	1182.39	26.13	1182.37	27.65	1182.33	30.56	1182.25	30.81	1182.24
31.01	1182.23	34.31	1182.11	36.87	1182	36.89	1182	43.76	1181.89
49.59	1181.8	50.76	1181.78	50.96	1181.78	51.46	1181.77	52.59	1181.75
55.73	1181.75	56.31	1181.76	56.53	1181.76	60.82	1181.84	62.17	1181.86
63.64	1181.89	65.84	1181.93	66.7	1181.94	67.74	1181.96	68.47	1181.97
69.98	1181.99	70.55	1182	71.92	1182.02	72.1	1182.02	73.98	1182.05
74.49	1182.06	76.12	1182.08	76.97	1182.1	78.23	1182.12	79.31	1182.13
80.15	1182.15	81.23	1182.16	81.72	1182.17	81.96	1182.18	82.71	1182.19
82.94	1182.19	83.25	1182.2	83.57	1182.2	84.27	1182.21	84.51	1182.21
85.76	1182.23	85.89	1182.23	87.65	1182.25	87.95	1182.25	89.41	1182.26
91.03	1182.27	91.17	1182.27	98.77	1182.29	100.4	1182.29	101.66	1182.28
103.99	1182.28	104.71	1182.27	105.03	1182.27	109.65	1182.25	111.12	1182.25
112.1	1182.23	112.2	1182.23	113.1	1182.22	113.56	1182.21	113.68	1182.21
114.48	1182.2	114.58	1182.2	115.52	1182.18	115.87	1182.18	116.72	1182.16
117.1	1182.16	118.09	1182.14	118.58	1182.14	122.78	1182.05	123.24	1182.04
124.67	1182	128.13	1181.84	129.46	1181.78	130.21	1181.75	135.11	1181.75
135.27	1181.76	135.33	1181.76	138.86	1181.85	140.15	1181.87	142.01	1181.91
144.24	1181.93	149.24	1182	150.39	1182	152.69	1182	154.39	1182.01
156.28	1182.01	157.09	1182.02	157.35	1182.03	159.06	1182.04	161.03	1182.05
161.49	1182.05	162.12	1182.07	163	1182.08	164.11	1182.1	164.39	1182.11
165.52	1182.13	165.99	1182.14	166.54	1182.15	166.82	1182.15	169.22	1182.2
171.56	1182.25	171.71	1182.34	171.95	1182.5	172.17	1182.65	172.33	1182.75
172.66	1182.97	172.71	1183	172.89	1183.12	173.09	1183.25	173.22	1183.34
173.47	1183.5	173.77	1183.7	173.85	1183.75	174.03	1183.88	174.3	1184.06
174.84	1184.44	174.93	1184.5	175.06	1184.59	175.29	1184.75	175.37	1184.81
175.64	1185	175.95	1185.22	175.99	1185.25	176.23	1185.25	176.26	1185.11
176.27	1185	176.31	1184.79	176.32	1184.75	176.35	1184.5	176.37	1184.28
176.38	1184.25	176.38	1184.19	176.4	1184	176.42	1183.84	176.43	1183.75
176.43	1183.69	176.45	1183.5	176.95	1183.5	177	1183.75	177.04	1183.98
177.05	1184	177.05	1184.03	177.06	1184.09	177.09	1184.25	177.1	1184.37
177.12	1184.5	177.15	1184.75	177.16	1184.79	177.18	1185	177.19	1185.04
177.2	1185.25	177.37	1185.3	178.08	1185.5	178.42	1185.61	178.89	1185.75
179.34	1185.89	179.69	1186	180.42	1186.23	180.47	1186.25	180.59	1186.29
181.24	1186.5	181.72	1186.66	182	1186.75	182.57	1186.94	182.76	1187
182.97	1187.07	183.54	1187.25	184.67	1187.34	186.59	1187.5	189.23	1187.67
190.53	1187.75	194.26	1187.99	194.44	1188	195.58	1188.07	195.85	1188.09

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	98.77	.03	175.95	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
98.77	175.95	32.96	32.42	31.88	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
0	38	1186	F

Right Levee Station= 176.22 Elevation= 1185.25

CROSS SECTION

RIVER: Khowst
REACH: Reach1 RS: 53.3

INPUT
Description:
Station Elevation Data num= 200

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1182.22	3.68	1182.25	3.96	1182.25	3.97	1182.24	4.21	1182.24
4.35	1182.23	4.74	1182.21	5.38	1182.19	5.46	1182.18	5.62	1182.18
6.46	1182.15	6.72	1182.14	7.4	1182.12	7.69	1182.11	7.88	1182.11
8.37	1182.1	9.31	1182.07	9.87	1182.07	10.21	1182.07	10.61	1182.07
10.96	1182.06	11.32	1182.06	11.54	1182.06	11.85	1182.06	12.15	1182.06
12.87	1182.06	13.13	1182.05	14.19	1182.05	14.38	1182.05	14.58	1182.05
14.75	1182.05	16.04	1182.05	16.17	1182.05	17.62	1182.04	19.14	1182.04
20.63	1182.03	21.42	1182.03	23.67	1182	24.32	1182	24.76	1182
25.02	1182	25.21	1182	26.3	1181.98	26.52	1181.98	28.69	1181.94
29.69	1181.92	31.63	1181.89	34.17	1181.84	35.27	1181.82	38.52	1181.75
39.3	1181.74	39.37	1181.74	41.78	1181.71	41.96	1181.71	43.9	1181.69
44.04	1181.69	49.9	1181.69	65.79	1181.7	67.64	1181.72	69.73	1181.75
70.06	1181.75	74.9	1181.84	76.72	1181.87	81.4	1181.95	82.29	1181.97
82.82	1181.98	83.3	1181.99	83.4	1181.99	83.43	1181.99	83.47	1181.99
83.5	1181.99	83.64	1181.99	83.69	1181.99	83.99	1182	84.43	1182
84.49	1182	84.51	1182	85.03	1182	85.11	1182	85.53	1182
85.64	1182	86.33	1182	86.64	1182	86.92	1182	87.1	1182
87.35	1182	87.71	1182	88.74	1181.97	89.69	1181.94	91.29	1181.89
92.14	1181.86	92.51	1181.85	95.52	1181.75	96.01	1181.73	96.54	1181.72
99.23	1181.63	103.24	1181.5	104.27	1181.5	106.14	1181.5	108.18	1181.53
108.64	1181.54	120.47	1181.75	121.62	1181.75	128.03	1181.75	128.07	1181.75
128.96	1181.75	148	1181.94	150.84	1181.96	151.69	1181.97	154.73	1182
154.78	1182	154.81	1182	155.09	1182	155.2	1182	155.54	1182
168.15	1182.25	168.23	1182.25	168.41	1182.25	168.88	1182.49	168.89	1182.5
169.37	1182.75	169.38	1182.75	169.85	1183	170.18	1183.17	170.33	1183.25
170.59	1183.38	170.82	1183.5	170.98	1183.58	171.3	1183.75	171.66	1183.94
171.78	1184	172.2	1184.22	172.26	1184.25	172.39	1184.32	172.74	1184.5
172.92	1184.59	173.21	1184.74	173.22	1184.75	173.56	1184.75	173.68	1184.75
173.7	1184.65	173.72	1184.5	173.75	1184.35	173.76	1184.25	173.79	1184.09
173.8	1184	173.82	1183.88	173.84	1183.75	173.88	1183.51	173.88	1183.5
173.89	1183.5	173.92	1183.5	174.33	1183.5	174.46	1183.5	174.47	1183.61
174.48	1183.75	174.5	1183.92	174.51	1184	174.52	1184.08	174.54	1184.25
174.56	1184.42	174.57	1184.5	174.58	1184.6	174.59	1184.75	174.6	1184.8
174.62	1185	174.71	1185.19	174.72	1185.21	174.74	1185.25	174.79	1185.26
176.07	1185.5	177.34	1185.73	177.42	1185.75	177.53	1185.77	178.78	1186
179.15	1186.07	180.16	1186.25	181.5	1186.49	181.55	1186.5	181.66	1186.52
182.95	1186.75	184.24	1186.99	184.28	1186.99	184.32	1187	184.35	1187
185.98	1187.25	187.34	1187.42	187.81	1187.48	187.93	1187.5	188.09	1187.52
188.81	1187.61	189.95	1187.75	191.54	1187.91	192.61	1188	194.33	1188.09
196.71	1188.23	196.94	1188.24	197.07	1188.25	199.72	1188.37	201.05	1188.43

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	85.11	.03	173.22	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
85.11	173.22	34.3	34.17	34.04	.1	.3

Right Levee Station= 173.67 Elevation= 1184.75

CROSS SECTION

RIVER: Khowst
REACH: Reach1 RS: 19.1

INPUT
Description:
Station Elevation Data num= 183

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev

0	1181.73	3.65	1181.75	4.2	1181.75	7.78	1181.75	8.03	1181.75
8.54	1181.75	9.01	1181.75	9.29	1181.75	9.66	1181.75	10.11	1181.75
10.34	1181.75	10.96	1181.75	11.72	1181.75	12.59	1181.75	13.48	1181.75
15.41	1181.75	16.6	1181.75	16.71	1181.75	18.66	1181.75	18.72	1181.75
19.4	1181.75	21.9	1181.75	23.86	1181.75	25.7	1181.75	27.55	1181.75
30.33	1181.61	31.48	1181.55	32.08	1181.52	32.77	1181.5	32.81	1181.5
32.83	1181.5	33.26	1181.5	33.38	1181.5	33.92	1181.5	35.77	1181.45
36.23	1181.44	37.7	1181.42	38.5	1181.4	39.73	1181.38	40.86	1181.36
41.72	1181.34	43.07	1181.31	43.54	1181.3	44.92	1181.27	45.07	1181.27
46.02	1181.25	46.22	1181.24	46.24	1181.24	46.9	1181.23	47.55	1181.21
47.74	1181.21	48.69	1181.19	49.07	1181.18	50.12	1181.16	50.74	1181.15
51.69	1181.13	52.53	1181.12	53.28	1181.1	53.84	1181.09	54.26	1181.08
54.76	1181.07	55.75	1181.05	56.03	1181.05	56.36	1181.04	56.52	1181.04
56.59	1181.04	56.65	1181.04	56.73	1181.03	56.8	1181.03	61.26	1181.05
61.47	1181.05	63.11	1181.05	63.3	1181.05	63.49	1181.05	63.66	1181.06
63.79	1181.06	64.61	1181.06	64.75	1181.07	65.01	1181.07	66.31	1181.08
66.72	1181.09	67.8	1181.1	68.35	1181.11	69.06	1181.12	69.86	1181.13
70.65	1181.15	71.19	1181.15	71.53	1181.16	72.3	1181.17	72.42	1181.17
72.98	1181.18	73.1	1181.18	73.43	1181.19	74.36	1181.19	74.42	1181.19
74.56	1181.19	74.58	1181.19	74.63	1181.19	74.68	1181.19	74.83	1181.19
75.15	1181.19	75.69	1181.18	76.45	1181.16	77.18	1181.14	82.11	1181.25
83.14	1181.25	84.59	1181.25	85.15	1181.25	86.33	1181.25	87.26	1181.25
91.74	1181.25	97.2	1181.33	97.59	1181.33	99.52	1181.36	101.64	1181.39
102.46	1181.4	103.18	1181.41	104.12	1181.43	104.63	1181.44	105.84	1181.46
107.15	1181.48	107.25	1181.49	107.96	1181.5	108.12	1181.5	109.6	1181.5
109.91	1181.5	110.39	1181.5	112.12	1181.5	121.17	1181.63	121.54	1181.63
121.69	1181.63	131.25	1181.75	131.4	1181.75	132.06	1181.75	132.16	1181.75
132.8	1181.75	133.24	1181.75	135.21	1181.75	135.32	1181.75	136.82	1181.75
137.13	1181.75	137.59	1181.75	138.8	1181.75	139.5	1181.75	140.2	1181.75
146.68	1181.75	155.17	1181.75	155.44	1181.75	155.45	1181.75	155.46	1181.75
161.33	1181.83	161.77	1181.85	161.78	1181.85	162.46	1181.89	163.47	1181.94
163.49	1181.94	164.63	1182	164.66	1182.09	164.73	1182.25	164.81	1182.48
164.81	1182.5	164.82	1182.52	164.9	1182.75	164.91	1182.78	164.95	1182.9
164.98	1183	165.76	1183.02	174.94	1183.25	174.96	1183.27	175.27	1183.5
175.31	1183.53	175.65	1183.75	175.98	1183.96	176.05	1184	176.16	1184.04
176.6	1184.25	177.13	1184.38	177.65	1184.5	178.55	1184.71	178.73	1184.75
179.15	1184.85	179.81	1185	179.95	1185				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	27.55	.03	165.76	.03

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
27.55	165.76	19.02	19.15	14.86	.1	.3

SUMMARY OF MANNING'S N VALUES

River:Khowst

Reach	River Sta.	n1	n2	n3
Reach1	442.4	.03	.03	.03
Reach1	404.5	.03	.03	.03
Reach1	374.8	.03	.03	.03
Reach1	349.4	.03	.03	.03
Reach1	323.9	.03	.03	.03
Reach1	288.3	.03	.03	.03
Reach1	253.5	.03	.03	.03
Reach1	246.8	.03	.03	.03
Reach1	242.3	.03	.03	.03
Reach1	235.7	Bridge		

Reach1	229.1	.03	.03	.03
Reach1	217.5	.03	.03	.03
Reach1	203.0	.03	.03	.03
Reach1	189.8	.03	.03	.03
Reach1	178.2	.03	.03	.03
Reach1	158.7	.03	.03	.03
Reach1	139.8	.03	.03	.03
Reach1	113.9	.03	.03	.03
Reach1	85.7	.03	.03	.03
Reach1	53.3	.03	.03	.03
Reach1	19.1	.03	.03	.03

SUMMARY OF REACH LENGTHS

River: Khowst

Reach	River Sta.	Left	Channel	Right
Reach1	442.4	38.39	37.93	36.85
Reach1	404.5	24.56	29.7	32.53
Reach1	374.8	24.08	25.43	28.97
Reach1	349.4	25.99	25.41	24.87
Reach1	323.9	41.99	35.66	34.62
Reach1	288.3	35.93	34.74	33.46
Reach1	253.5	6.65	6.77	6.89
Reach1	246.8	4.5	4.5	4.5
Reach1	242.3	13.2	13.2	13.2
Reach1	235.7	Bridge		
Reach1	229.1	11.25	11.51	11.76
Reach1	217.5	14.15	14.53	14.91
Reach1	203.0	12.91	13.19	13.47
Reach1	189.8	10.85	11.58	12.32
Reach1	178.2	18.59	19.58	20.56
Reach1	158.7	17.86	18.82	19.79
Reach1	139.8	24.41	25.9	27.38
Reach1	113.9	26.6	28.2	30.23
Reach1	85.7	32.96	32.42	31.88
Reach1	53.3	34.3	34.17	34.04
Reach1	19.1	19.02	19.15	14.86

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Khowst

Reach	River Sta.	Contr.	Expan.
Reach1	442.4	.1	.3
Reach1	404.5	.1	.3
Reach1	374.8	.1	.3
Reach1	349.4	.1	.3
Reach1	323.9	.1	.3
Reach1	288.3	.1	.3
Reach1	253.5	.3	.5
Reach1	246.8	.3	.5
Reach1	242.3	.1	.3
Reach1	235.7	Bridge	
Reach1	229.1	.3	.5

Reach1	217.5	.1	.3
Reach1	203.0	.1	.3
Reach1	189.8	.1	.3
Reach1	178.2	.1	.3
Reach1	158.7	.1	.3
Reach1	139.8	.1	.3
Reach1	113.9	.1	.3
Reach1	85.7	.1	.3
Reach1	53.3	.1	.3
Reach1	19.1	.1	.3

Profile Output Table - Standard Table 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Reach1	442.4	PF 1	680.00	1185.43	1186.83		1187.08	0.004900	2.32	309.90	340.36	0.74
Reach1	404.5	PF 1	680.00	1185.13	1186.67		1186.90	0.004222	2.20	321.47	333.16	0.69
Reach1	374.8	PF 1	680.00	1185.18	1186.59	1186.28	1186.80	0.003171	1.95	335.25	341.99	0.60
Reach1	349.4	PF 1	680.00	1184.74	1186.52	1186.14	1186.72	0.002718	1.95	339.33	355.07	0.57
Reach1	323.9	PF 1	680.00	1184.50	1186.42	1186.02	1186.65	0.002804	2.17	320.56	330.25	0.59
Reach1	288.3	PF 1	680.00	1184.14	1186.21	1185.93	1186.52	0.003917	2.48	275.93	312.33	0.69
Reach1	253.5	PF 1	680.00	1184.25	1186.12	1185.70	1186.39	0.002851	2.33	294.59	328.37	0.61
Reach1	246.8	PF 1	680.00	1184.25	1186.07	1185.66	1186.35	0.002936	2.37	290.43	324.42	0.62
Reach1	242.3	PF 1	680.00	1184.25	1186.06	1185.63	1186.34	0.002881	2.33	292.12	320.48	0.61
Reach1	235.7			Bridge								
Reach1	229.1	PF 1	680.00	1184.25	1185.75	1185.49	1186.01	0.004261	2.44	267.45	318.24	0.71
Reach1	217.5	PF 1	680.00	1184.03	1185.24	1185.24	1185.74	0.008329	2.78	220.51	350.10	0.94
Reach1	203.0	PF 1	680.00	1182.34	1184.53	1184.36	1184.89	0.004644	2.81	258.16	308.27	0.76
Reach1	189.8	PF 1	680.00	1182.25	1184.48	1184.29	1184.83	0.004250	2.78	264.08	332.21	0.73
Reach1	178.2	PF 1	680.00	1182.25	1184.49	1184.13	1184.77	0.002928	2.42	297.04	338.54	0.61
Reach1	158.7	PF 1	680.00	1181.85	1184.35	1184.01	1184.70	0.003194	2.80	263.46	290.04	0.66
Reach1	139.8	PF 1	680.00	1181.75	1183.92	1183.91	1184.58	0.008013	3.67	189.13	249.01	0.99
Reach1	113.9	PF 1	680.00	1182.00	1183.67	1183.67	1184.37	0.007939	3.78	183.30	177.67	1.00
Reach1	85.7	PF 1	680.00	1181.75	1183.41	1183.41	1184.10	0.008045	3.63	184.96	173.33	1.00
Reach1	53.3	PF 1	680.00	1181.50	1183.04	1183.04	1183.63	0.008404	3.44	200.24	169.93	1.00
Reach1	19.1	PF 1	680.00	1181.03	1182.70	1182.70	1183.31	0.008339	3.52	197.82	164.88	1.01

HEC-RAS Plan: 100 m updated River: Khowst Reach: Reach1 Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Reach1	442.4	PF 1	680.00	1185.43	1186.83		1187.08	0.004900	2.32	309.90	340.36	0.74
Reach1	404.5	PF 1	680.00	1185.13	1186.67		1186.90	0.004222	2.20	321.47	333.16	0.69
Reach1	374.8	PF 1	680.00	1185.18	1186.59	1186.28	1186.80	0.003171	1.95	335.25	341.99	0.60
Reach1	349.4	PF 1	680.00	1184.74	1186.52	1186.14	1186.72	0.002718	1.95	339.33	355.07	0.57
Reach1	323.9	PF 1	680.00	1184.50	1186.42	1186.02	1186.65	0.002804	2.17	320.56	330.25	0.59
Reach1	288.3	PF 1	680.00	1184.14	1186.21	1185.93	1186.52	0.003917	2.48	275.93	312.33	0.69
Reach1	253.5	PF 1	680.00	1184.25	1186.12	1185.70	1186.39	0.002851	2.33	294.59	328.37	0.61
Reach1	246.8	PF 1	680.00	1184.25	1186.07	1185.66	1186.35	0.002936	2.37	290.43	324.42	0.62
Reach1	242.3	PF 1	680.00	1184.25	1186.06	1185.63	1186.34	0.002881	2.33	292.12	320.48	0.61
Reach1	235.7		Bridge									
Reach1	229.1	PF 1	680.00	1184.25	1185.75	1185.49	1186.01	0.004261	2.44	267.45	318.24	0.71
Reach1	217.5	PF 1	680.00	1184.03	1185.24	1185.24	1185.74	0.008329	2.78	220.51	350.10	0.94
Reach1	203.0	PF 1	680.00	1182.34	1184.53	1184.36	1184.89	0.004644	2.81	258.16	308.27	0.76
Reach1	189.8	PF 1	680.00	1182.25	1184.48	1184.29	1184.83	0.004250	2.78	264.08	332.21	0.73
Reach1	178.2	PF 1	680.00	1182.25	1184.49	1184.13	1184.77	0.002928	2.42	297.04	338.54	0.61
Reach1	158.7	PF 1	680.00	1181.85	1184.35	1184.01	1184.70	0.003194	2.80	263.46	290.04	0.66
Reach1	139.8	PF 1	680.00	1181.75	1183.92	1183.91	1184.58	0.008013	3.67	189.13	249.01	0.99
Reach1	113.9	PF 1	680.00	1182.00	1183.67	1183.67	1184.37	0.007939	3.78	183.30	177.67	1.00
Reach1	85.7	PF 1	680.00	1181.75	1183.41	1183.41	1184.10	0.008045	3.63	184.96	173.33	1.00
Reach1	53.3	PF 1	680.00	1181.50	1183.04	1183.04	1183.63	0.008404	3.44	200.24	169.93	1.00
Reach1	19.1	PF 1	680.00	1181.03	1182.70	1182.70	1183.31	0.008339	3.52	197.82	164.88	1.01

Section 2
Geotechnical

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Design Analysis

Discipline:	Geotechnical	Date:	September 29, 2011

Design Submittal: Final Design Submittal
Site Location: Khost Province, Afghanistan
Prepared By: Tetra Tech

I. General Summary:

The existing Sagai wadi, located in the province of Khost Afghanistan, floods during periods of the spring ice melting and the summer rainy season. During these periods, the existing concrete roadway across the wadi overtops and the 315m crossing is impassable. In addition, due to the strong flows and the scour-susceptible soils at the site, the concrete road is deteriorated.

The objective is to perform final design for a new bridge crossing adjacent to the concrete roadway. The proposed bridge superstructure and substructure will be constructed out of reinforced concrete. Approach roadway work will be required to transition from the existing roadway to the bridge. Riprap will be used to protect the substructure and approaches, as required for scour protection.

II. Detailed Analysis:

A geotechnical field investigation was performed on May 24, 2011 and June 1, 2011 by Others. Soil samples were obtained from 12 boreholes drilled along the alignment of the proposed bridge and 12 test pits. Laboratory analysis of the samples was also performed to obtain engineering characteristics of the bridge's subgrade.

After review of laboratory analysis results presented in the soil investigation report developed by Others and evaluation of construction techniqes and means available in the area, it was decided to construct spread footings at the abutments and piers of the bridge.

The groundwater level and channel grade were assumed when calculating bearing capacity, active soil pressure forces, and passive resistance forces. The soil investigation report presented bearing capacity recommendations. These recommendations were not used since the results were obtained assuming the soils were not submerged. Tetra Tech's calculations assumed a submerged soil scenario and provided conservatism in the calculations by decreasing the soil's allowable bearing capacity and passive resistance forces.

Once the footing widths were determined based on the obtained bearing capacity, the footings were checked for overall stability, sliding, and overturning. Dead load, live load and seismic forces were used to perform these checks in addition to active soil pressure forces and passive resistance forces.

The annual construction season is restricted to approximately six months, including mobilization and demobilization, due to seasonal spring thaws and the summer rainy season. The substructure construction will require a large labor force, as well as potentially dewatering and support-of-excavation in order to construct the proposed foundation in the dry.

III. Basis of Design

- Groundwater level at channel grade.
- Submerged unit weight of soil
- Factor of Safety = 2.5

IV. Material Properties

Soil properties:

- Dry Unit Weight of Soil 18.6 kN/m^3 (118 pcf)
- Submerged Unit Weight of Soil 8.8 KN/m^3 (55.6 pcf)
- Allowable Soil Bearing Pressure (abutments) = 3.2 kg/cm^2 (6,554 psf)
- Allowable Soil Bearing Pressure (piers) = 1.97 kg/ cm^2 (4,046 psf)
- Friction Angle = 30 degrees
- Coefficient of Friction for Sliding = 0.50
- Ko = 0.5
- Ka = 0.33
- Kp = 2.1
- Compaction shall be 95% maximum dry density as per ASTM D 1557.
- The Contractor shall verify that the actual subsurface conditions meet the assumed geotechnical design parameters.

V. Code References

- AASHTO "Standard Specification for Highways and Bridges"

VI. List of Attachments:

Calculations

Calculations

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CALCULATION COVER SHEET

Client: USAID Project No.: 133-01304-10001

Project Name: Sagai Bridge Construction

Title: Soil Bearing Capacity

Total Number of Pages (including cover sheet): 3

Total Number of Computer Runs: 1

Prepared by: FJD Date: 9/22/2011

Checked by: RJT Date: 9/22/2011

Description and Purpose:

To calculate the allowable soil bearing pressure for design of the abutment and pier foundations.

Design Basis/References/Assumptions:

Groundwater level at channel grade.
Factor of Safety = 2.5
Soil Dry Unit Weight = δ_d = 118 lb/ft^3
Unit Weight of Water = δ_w = 62.4 lb/ft^3
Effective Angle of Friction = Φ' = 30°
Cohesion = c' = 0 lb/ft^2
Bearing Capacity Factor – cohesion = 37.16
Bearing Capacity Factor – stress = 22.46

Terzaghi's Ultimate Bearing Capacity Equation = B.C. = $c'N_c + D(\delta_d - \delta_w)N_q$
Allowable Bearing Capacity = Ultimate Bearing Capacity ÷ Factor of Safety

Remarks/Conclusions/Results:

Allowable bearing pressures are net pressures excluding foundation weight.

Allowable Average Bearing Capacity for Pier Foundations = 1.97 Kg/cm^2 (4,046 psf)
Allowable Average Bearing Capacity for Abutment Foundations = 3.2 Kg/cm^2 (6,554 psf)
Allowable maximum capacity at footing toe can be increased 40% over average value.

Scenario: North Abutment, groundwater level at channel grade

		Result field
		Input field

Soil Properties

Unit Weight	118	lb/ft3	
Effective Angle of Friction	30	degrees	
Cohesion	0	psf	
Bearing Capacity Factor - cohesion	37.16		
Bearing Capacity Factor - stress	22.46		
Bearing Capacity Factor - Unit Weight	19.13		
Factor of Safety	2.5		
Water Unit Weight	62.4	lb/ft3	
Groundwater Depth	0	ft	(from riverside grade)
Active Pressure Coefficient	0.33		
Passive Pressure Coefficient	2.1		
Footing embedment depth (active)	29	ft	USE SUBMERGED UNIT WEIGHT TO CALCULATE BEARING CAPACITY AND ACTIVE PRESSURE
Footing embedment depth (passive)	13.12	ft	USE SUBMERGED UNIT WEIGHT TO CALCUATE BEARING CAPACITY AND PASSIVE PRESSURE

DRY UNIT WEIGHT			**SUBMERGED UNIT WEIGHT**		
Active Pressure	1141	psf	868	psf	
Active Pressure Load	16540	lb/ft	12583	lb/ft	
Passive Pressure	3251	psf	1532	psf	
Passive Pressure Load	47141	lb/ft	10049	lb/ft	
		calculate q=	729	psf	(q for dry and wet depths up to footing depth)
Ultimate Bearing Capacity	34772	psf	16384	psf	
Allowable Bearing Capacity	13909	psf	6554	psf	

Scenario: Bridge Piers, footing 2.469 m deep, groundwater at channel grade

		Result field
		Input field

Soil Properties

Unit Weight	118	lb/ft3	
Effective Angle of Friction	30	degrees	
Cohesion	0	psf	
Bearing Capacity Factor - cohesion	37.16		
Bearing Capacity Factor - stress	22.46		
Bearing Capacity Factor - Unit Weight	19.13		
Factor of Safety	2.5		
Water Unit Weight	62.4	lb/ft3	
Groundwater Depth	0	ft	(from riverside grade)
Active Pressure Coefficient	0.33		
Passive Pressure Coefficient	2.1		
Footing embedment depth (active)	8.1	ft	USE SUBMERGED UNIT WEIGHT TO CALCULATE BEARING CAPACITY AND ACTIVE PRESSURE
Footing embedment depth (passive)	8.1	ft	USE SUBMERGED UNIT WEIGHT TO CALCUATE BEARING CAPACITY AND PASSIVE PRESSURE

DRY UNIT WEIGHT				**SUBMERGED UNIT WEIGHT**	
Active Pressure	319	psf		150	psf
Active Pressure Load	1290	lb/ft		608	lb/ft
Passive Pressure	2007	psf		946	psf
Passive Pressure Load	8129	lb/ft		3830	lb/ft
			calculate q=	450	psf
Ultimate Bearing Capacity	21467	psf		10115	psf
Allowable Bearing Capacity	8587	psf		4046	psf

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Section 3
Civil

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Design Analysis

Discipline:	Civil	Date:	September 29, 2011

Design Submittal: Final Design Submittal
Site Location: Khost Province, Afghanistan
Prepared By: Tetra Tech

I. General Summary:

The existing Sagai wadi, located in the province of Khost Afghanistan, floods during periods of the spring ice melting and the summer rainy season. During these periods, the existing concrete roadway across the wadi overtops and the 315m crossing is impassable. In addition, due to the strong flows and the scour-susceptible soils at the site, the concrete road is deteriorated.

The objective is to perform final design for a new bridge crossing adjacent to the concrete roadway. The proposed bridge superstructure and substructure is constructed out of reinforced concrete. Approach roadway work will be required to transition from the existing roadway to the bridge. The roadway approach work will be kept to a minimum to minimize impacts to the adjacent areas. Riprap will be used to protect the substructure and approaches, as required for scour protection.

II. Basis of Design

- The roadway approaches consist of unpaved normal crown gravel surfaces with 1.5 meter shoulders. The travel way varies in width between 4 meters (existing) and 7.4 meters (travel way on bridge). The approaches quickly transition over approximately 100 meters to match the existing gravel roadway width.

- Horizontal and vertical alignments were designed for approximately 40 kph (25 mph) providing improved sight distance on the bridge approaches.

- Embankments adjacent to the river will be protected with rip rap stone.

- Stone masonry walls are provided along the proposed roadway approaches to assist in guiding vehicles to the bridge crossing. The design of the stone masonry walls is not intended to be for impact.

III. Material Properties

- Approach roadway surface: Processed gravel intended to be obtained and manufactured locally.

- Approach roadway fill: Select fill intended to be obtained locally.

- Stone masonry walls and Rip Rap: Stones intended to be obtained locally.

- Compaction of soil materials for roadway base courses and embankments shall be 95% maximum dry density as per ASTM D1557.

IV. Code References

- US Army Corps of Engineers Afghanistan Engineer District AED Design Requirements: Vertical Curve Design and Superelevation Road Design March 2009

- AASHTO "Standard Specification for Highways and Bridges," 17th Edition, 2002.

Section 4
Structural

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Design Analysis

Discipline:	Structural	Date:	September 29, 2011

Design Submittal: Final Design Submittal
Site Location: Khost Province, Afghanistan
Prepared By: Tetra Tech

I. General Summary:

The existing Sagai wadi, located in the province of Khost Afghanistan, floods during periods of the spring ice melting and the summer rainy season. During these periods, the existing concrete roadway across the wadi overtops and the 315m crossing is impassable. In addition, due to the strong flows and the scour-susceptible soils at the site, the concrete road is deteriorated.

The objective is to perform final design for a new bridge crossing adjacent to the concrete roadway. The proposed bridge superstructure and substructure are constructed out of reinforced concrete. Approach roadway work will be required to transition from the existing roadway to the bridge. Riprap will be used to protect the substructure and approaches, as required for scour protection.

II. Detailed Analysis:

The proposed thirteen-span reinforced concrete bridge is comprised of 15 meter simple spans, with a total bridge length of 195 meters. The superstructure (girder, slab and barriers) and the substructure (abutments and piers) shall be reinforced concrete. The roadway carries two 3.7m lanes of traffic and has a 1.2 m wide sidewalk on one side. The bridge is designed for an AASHTO HS-25 vehicle, as well as a Military Load Class MLC-70 vehicle configuration.

The annual construction season is restricted to approximately six months, including mobilization and demobilization, due to seasonal spring thaws and the summer rainy season. The substructure construction will require a large labor force, as well as potentially dewatering and support-of-excavation in order to construct the proposed foundation in the dry. Substructure construction is anticipated to occur during the first construction season.

The superstructure construction is anticipated to occur during the second construction season. If a crane is available, the beams can be precast offsite or on the approaches and placed using a crane. Using precast beams would accelerate the superstructure construction considerably. Since the reinforced concrete superstructure is heavy, deep girders are required to carry the load. The proposed bridge seat elevation has been set 0.6m (2 ft) above the 100-year flood elevation. For related approach roadway work and limits of work, see the Civil section.

At the southern approach to the bridge, there is an existing small channel with walls constructed of either stone masonry or earthern berms. Since proposed fill is required at the southern approach, a reinforced concrete box culvert is used maintain the channel under the approach roadway. The proposed concrete culvert is 23.4 m long and 2.1 m wide, with ends that butt up against the existing earthern berm channel walls.

The superstructure, abutments, piers and culvert have been designed to resist all applied loads as described in AASHTO "Standard Specification for Highways and Bridges," 17th Edition, 2002. See the "Basis of Design" for design load information.

III. Basis of Design

- Dead Load: Selfweight of superstructure and substructure components
- Live Load: AASHTO HS-25 Truck and a Military Load Class MLC-70 Vehicle Configuration
- Longitudinal Force: 5% of Live Load
- Wind Load: Superstructure:
  2.39 kPa (50 psf) Transverse
  0.57 kPa (12 psf) Longitudinal
  Substructure:
  1.92 kPa (40 psf)
- Wind on Live Load: 144 kN/m (100 plf)
- Stream Pressure: Pavg = 477.5 kg/m^2 (97.8 psf)
  Pmax = 955.0 kg/m^2 (195.6 psf)
- Seismic Load: Ss = 0.21g
  S1 = 0.17g
  SPC B
  PGA = 0.17g
- Hydraulic: Watershed Area = 1511 square kilometers.
  Design Flood Event = 100-yr
  Design Discharge = 680 m^3/s
  Design Velocity = 3.8 m/s
  Design Groundwater Elevation = 1186.19m
  Scour Depth at Piers = 1.50m + 0.75m additional
  Scour Depth at Abutments = 3.0m + 1.0m additional
- Load combinations are based on AASHTO "Standard Specification for Highways and Bridges," 17th Edition, 2002.
- Service Loads (Allowable Stress Design) are used for substructure stability and bearing pressure calculations.
- Load Factor Design is used for the superstructure and substructure concrete and reinforcement design.
- Allowable bearing capacity is based on 25mm (1 inch) settlement. An allowable overstress of 1.33 is taken for earthquake and wind load combinations as allowed by AASHTO.

IV. Material Properties

Concrete Properties:

- Concrete mix shall be ASTM C-150 Type 1 or Type 2 Portland Cement.
- f'c = 27.5 MPa (4000 psi)
- Reinforcement: fy = 4218 kg/cm^2 (60 ksi)

Soil properties:

- Weight of Soil 18.6 kN/m^3 (118 pcf)
- Allowable Soil Bearing Pressure (Average Net Pressure)
  - Abutments = 3.2 kg/cm^2 (6.554 ksf)
  - Piers = 1.97 kg/cm^2 (4.046 ksf)
- Friction Angle = 30 degrees
- Coefficient of Friction for Sliding = 0.50
- Ko = 0.5
- Ka = 0.33
- Kp = 2.1
- Modulus of Subgrade Reaction = 54,289 kN/m^3 (200 pci)
- Compaction shall be 95% maximum dry density as per ASTM D 1557.
- The Contractor shall verify that the actual subsurface conditions meet the assumed geotechnical design parameters.

V. Code References

- AASHTO "Standard Specification for Highways and Bridges," 17th Edition, 2002.

VI. List of Attachments:

Calculations

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Calculations

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SAGAI CROSSING BRIDGE CONSTRUCTION PROJECT
KHOST, AFGHANISTAN

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CONSPAN

INPUT / RESULTS

The results presented are for Span 1 beam 2

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Bentley			Sheet #	DS-1
			Job #	
Program:	LEAP® CONSPAN® V8i (SELECTseries 2)	EAS-RAI-USA	Designed By	alh
Version:	10.00.01.20	Copyright © Bentley Systems, Inc. 1984 - 2011	Date	Sept/12/2011
		www.bentley.com Phone: 1-800-778-4277	Checked	SAM
File Name:	Khost_SS_600x1250.csl		Date	

PROJECT DATA

Project:	Khost Bridge
Designer:	
Date:	Sept/12/2011
Checked By:	
Date Checked:	
User job number:	
State:	, State Job #:
State Specification:	None
Design Code:	AASHTO STANDARD (LFD) - [17th Edition, 2003]
Units:	US
Span Type:	Multi-Span (Non-Continuous)
Flared Girder:	No
Comments:	Rectangular Concrete Beam (600mm X 1250mm)
File Name:	P:\1298\127-1298-10001-LT0009\SupportDocs\Calcs\Khost Bridge\Conspan\600x1250 Beam\Khost_SS_600x1250.csl

GEOMETRY DATA
BRIDGE LAYOUT

Overall Width (ft)	31.168
Left curb (ft)	1.476
Right curb (ft)	1.476
curb-to-curb width (ft)	28.215
Number of spans	13
Number of lanes	2
Lane width (ft)	12.139
Eff Deck thick (in)	8.858
Sacrificial thick (in)	7.126
Haunch thickness (in)	0.000
Haunch width (in)	0.000

SPAN DATA

Span	Pier-to-pier ft	Precast ft	Brg-to-brg ft	Pier CL ft	Release ft	StartSkew	EndSkew	Bridge c/s M.I. in4
1	49.213	49.213	49.213	0.000	49.213	0.00	0.00	2973847.75
2	49.213	49.213	49.213	0.000	49.213	0.00	0.00	2973847.75
3	49.213	49.213	49.213	0.000	49.213	0.00	0.00	2973847.75
4	49.213	49.213	49.213	0.000	49.213	0.00	0.00	2973847.75
5	49.213	49.213	49.213	0.000	49.213	0.00	0.00	2973847.75
6	49.213	49.213	49.213	0.000	49.213	0.00	0.00	2973847.75
7	49.213	49.213	49.213	0.000	49.213	0.00	0.00	2973847.75
8	49.213	49.213	49.213	0.000	49.213	0.00	0.00	2973847.75
9	49.213	49.213	49.213	0.000	49.213	0.00	0.00	2973847.75
10	49.213	49.213	49.213	0.000	49.213	0.00	0.00	2973847.75
11	49.213	49.213	49.213	0.000	49.213	0.00	0.00	2973847.75
12	49.213	49.213	49.213	0.000	49.213	0.00	0.00	2973847.75
13	49.213	49.213	49.213	0.000	49.213	0.00	0.00	2973847.75

BEAM DATA
Span: 1

No	ID	Loc-prev ft	Area in2	MI(Ixx) in4	Height in	Yb in	B-topg in	B-trib ft
1	600x1250	3.117	1162.5	234620.2	49.21	24.61	23.62	6.234
2	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
3	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
4	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
5	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234

Span: 2

No	ID	Loc-prev ft	Area in2	MI(Ixx) in4	Height in	Yb in	B-topg in	B-trib ft
1	600x1250	3.117	1162.5	234620.2	49.21	24.61	23.62	6.234
2	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234

No	ID	Loc-prev ft	Area in2	MI(Ixx) in4	Height in	Yb in	B-topg in	B-trib ft
3	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
4	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
5	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234

Span: 3

No	ID	Loc-prev ft	Area in2	MI(Ixx) in4	Height in	Yb in	B-topg in	B-trib ft
1	600x1250	3.117	1162.5	234620.2	49.21	24.61	23.62	6.234
2	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
3	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
4	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
5	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234

Span: 4

No	ID	Loc-prev ft	Area in2	MI(Ixx) in4	Height in	Yb in	B-topg in	B-trib ft
1	600x1250	3.117	1162.5	234620.2	49.21	24.61	23.62	6.234
2	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
3	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
4	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
5	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234

Span: 5

No	ID	Loc-prev ft	Area in2	MI(Ixx) in4	Height in	Yb in	B-topg in	B-trib ft
1	600x1250	3.117	1162.5	234620.2	49.21	24.61	23.62	6.234
2	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
3	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
4	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
5	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234

Span: 6

No	ID	Loc-prev ft	Area in2	MI(Ixx) in4	Height in	Yb in	B-topg in	B-trib ft
1	600x1250	3.117	1162.5	234620.2	49.21	24.61	23.62	6.234
2	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
3	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
4	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
5	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234

Span: 7

No	ID	Loc-prev ft	Area in2	MI(Ixx) in4	Height in	Yb in	B-topg in	B-trib ft
1	600x1250	3.117	1162.5	234620.2	49.21	24.61	23.62	6.234
2	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
3	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
4	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
5	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234

Span: 8

No	ID	Loc-prev ft	Area in2	MI(Ixx) in4	Height in	Yb in	B-topg in	B-trib ft
1	600x1250	3.117	1162.5	234620.2	49.21	24.61	23.62	6.234
2	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
3	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
4	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
5	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234

Span: 9

No	ID	Loc-prev ft	Area in2	MI(Ixx) in4	Height in	Yb in	B-topg in	B-trib ft
1	600x1250	3.117	1162.5	234620.2	49.21	24.61	23.62	6.234
2	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
3	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
4	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
5	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234

Span: 10

No	ID	Loc-prev ft	Area in2	MI(Ixx) in4	Height in	Yb in	B-topg in	B-trib ft
1	600x1250	3.117	1162.5	234620.2	49.21	24.61	23.62	6.234
2	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
3	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
4	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
5	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234

Span: 11

No	ID	Loc-prev ft	Area in2	MI(Ixx) in4	Height in	Yb in	B-topg in	B-trib ft
1	600x1250	3.117	1162.5	234620.2	49.21	24.61	23.62	6.234
2	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
3	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
4	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
5	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234

Span: 12

No	ID	Loc-prev ft	Area in2	MI(Ixx) in4	Height in	Yb in	B-topg in	B-trib ft
1	600x1250	3.117	1162.5	234620.2	49.21	24.61	23.62	6.234
2	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
3	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
4	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
5	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234

Span: 13

No	ID	Loc-prev ft	Area in2	MI(Ixx) in4	Height in	Yb in	B-topg in	B-trib ft
1	600x1250	3.117	1162.5	234620.2	49.21	24.61	23.62	6.234
2	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
3	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
4	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234
5	600x1250	6.234	1162.5	234620.2	49.21	24.61	23.62	6.234

MATERIAL DATA - Project Level

As defined in Material Tab. For beam level properties look at Beam Specific output.

CONCRETE PROPERTIES

	Precast Release	Precast Final	C.I.P
f'c (psi)	3988.540	3988.540	3988.540
Wc (pcf)	150.014	150.014	150.014
Ec (ksi)	3852.540	3852.540	3852.540

STRAND AND REBAR PROPERTIES

PRESTRESSED STEEL:
0.5", Low relaxation strands
Straight Pattern
Strand Diameter = 0.500 in
Ult. Strength(f's) = 270.0 ksi
Strand Area = 0.153 in2
Use transformed strand and rebar: No

REINFORCING STEEL:
Tension/Shear steel: fy = 60.0 ksi Es = 29008 ksi fs = 24.0 ksi

LOADS DATA

Loads generated using Permanent Load Wizard: YES

Left Barrier Weight, klf	0.505
Right Barrier Weight, klf	0.505
Left Curb Weight, klf	0.000
Right Curb Weight, klf	0.000
Left Sidewalk, klf	0.000
Right Sidewalk, klf	0.606
Future Wearing Surface, ksf	0.000
Sacrificial Wearing Surface, in	7.126
Stay in Place Deck Forms, klf	0.043

DEAD LOADS ON PRECAST

UNITS: (Point: kips, Location: ft, Line: klf, Trapez: klf)

Span	Beam	DL/ADL	Type	Mag.1	Loc.1	Mag.2	Loc.2	Description
1	1	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
1	1	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
1	2	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
1	2	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
1	3	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
1	3	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
1	4	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
1	4	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
1	5	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
1	5	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
2	1	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
2	1	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
2	2	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
2	2	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
2	3	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
2	3	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
2	4	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
2	4	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
2	5	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
2	5	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
3	1	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
3	1	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
3	2	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
3	2	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
3	3	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
3	3	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
3	4	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
3	4	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
3	5	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
3	5	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms

Bentley			Sheet #	DS-7
			Job #	
Program:	LEAP® CONSPAN® V8i (SELECTseries 2)	EAS-RAI-USA	Designed By	
Version:	10.00.01.20	Copyright © Bentley Systems, Inc. 1984 - 2011	Date	Sept/12/2011
		www.bentley.com Phone: 1-800-778-4277	Checked	SAM
File Name:	Khost_SS_600x1250.csl		Date	9/26/11

Span	Beam	DL/ADL	Type	Mag.1	Loc.1	Mag.2	Loc.2	Description
4	1	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
4	1	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
4	2	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
4	2	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
4	3	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
4	3	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
4	4	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
4	4	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
4	5	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
4	5	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
5	1	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
5	1	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
5	2	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
5	2	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
5	3	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
5	3	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
5	4	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
5	4	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
5	5	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
5	5	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
6	1	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
6	1	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
6	2	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
6	2	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
6	3	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
6	3	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
6	4	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
6	4	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
6	5	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
6	5	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
7	1	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
7	1	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
7	2	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
7	2	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
7	3	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
7	3	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
7	4	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
7	4	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
7	5	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
7	5	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
8	1	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
8	1	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
8	2	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
8	2	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
8	3	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
8	3	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
8	4	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
8	4	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
8	5	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
8	5	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
9	1	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface

Bentley			Sheet #	DS-8
			Job #	
Program:	LEAP® CONSPAN® V8i (SELECTseries 2)	EAS-RAI-USA	Designed By	
Version:	10.00.01.20	Copyright © Bentley Systems, Inc. 1984 - 2011	Date	Sept/12/2011
		www.bentley.com Phone: 1-800-778-4277	Checked	SAM
File Name:	Khost_SS_600x1250.csl		Date	9/26/11

Span	Beam	DL/ADL	Type	Mag.1	Loc.1	Mag.2	Loc.2	Description
	1	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
9	2	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
9	2	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
9	3	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
9	3	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
9	4	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
9	4	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
9	5	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
9	5	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
10	1	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
10	1	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
10	2	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
10	2	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
10	3	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
10	3	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
10	4	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
10	4	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
10	5	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
10	5	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
11	1	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
11	1	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
11	2	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
11	2	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
11	3	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
11	3	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
11	4	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
11	4	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
11	5	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
11	5	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
12	1	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
12	1	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
12	2	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
12	2	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
12	3	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
12	3	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
12	4	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
12	4	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
12	5	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
12	5	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
13	1	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
13	1	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
13	2	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
13	2	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
13	3	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
13	3	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
13	4	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
13	4	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms
13	5	DL	Line	0.555	0.000	0.555	49.213	Sacrificial Wearing Surface
13	5	DL	Line	0.043	0.000	0.043	49.213	Stay-in-Place Deck Forms

DIAPHRAGM LOADS

Span	Beam	Load (kips)	Location (ft)
1	1	0.016	0.000
1	1	0.016	24.603
1	2	0.031	0.000
1	2	0.032	24.603
1	3	0.031	0.000
1	3	0.031	24.606
1	4	0.031	0.000
1	4	0.031	24.606
1	5	0.016	0.000
1	5	0.016	24.606
1	5	0.016	49.213
2	1	0.016	0.000
2	1	0.016	0.000
2	1	0.016	24.606
2	2	0.031	24.606
2	3	0.031	24.606
2	4	0.031	24.606
2	5	0.016	24.606
3	1	0.016	0.000
3	1	0.016	0.000
3	1	0.016	24.606
3	2	0.031	24.606
3	3	0.031	24.606
3	4	0.031	24.606
3	5	0.016	24.606
4	1	0.016	0.000
4	1	0.016	0.000
4	1	0.016	24.606
4	2	0.031	24.606
4	3	0.031	24.606
4	4	0.031	24.606
4	5	0.016	24.606
5	1	0.016	0.000
5	1	0.016	0.000
5	1	0.016	24.606
5	2	0.031	24.606
5	3	0.031	24.606
5	4	0.031	24.606
5	5	0.016	24.606
6	1	0.016	0.000
6	1	0.016	0.000
6	1	0.016	24.606
6	2	0.031	24.606
6	3	0.031	24.606
6	4	0.031	24.606

Bentley			Sheet #	DS-10
			Job #	
Program:	LEAP® CONSPAN® V8i (SELECTseries 2)	EAS-RAI-USA	Designed By	
Version:	10.00.01.20	Copyright © Bentley Systems, Inc. 1984 - 2011	Date	Sept/12/2011
		www.bentley.com Phone: 1-800-778-4277	Checked	SAM
File Name:	Khost_SS_600x1250.csl		Date	9/26/11

Span	Beam	Load (kips)	Location (ft)
6	5	0.016	24.606
7	1	0.016	0.000
7	1	0.016	0.000
7	1	0.016	24.606
7	2	0.031	24.606
7	3	0.031	24.606
7	4	0.031	24.606
7	5	0.016	24.606
8	1	0.016	0.000
8	1	0.016	0.000
8	1	0.016	24.606
8	2	0.031	24.606
8	3	0.031	24.606
8	4	0.031	24.606
8	5	0.016	24.606
9	1	0.016	0.000
9	1	0.016	0.000
9	1	0.016	24.606
9	2	0.031	24.606
9	3	0.031	24.606
9	4	0.031	24.606
9	5	0.016	24.606
10	1	0.016	0.000
10	1	0.016	0.000
10	1	0.016	24.606
10	2	0.031	24.606
10	3	0.031	24.606
10	4	0.031	24.606
10	5	0.016	24.606
11	1	0.016	0.000
11	1	0.016	0.000
11	1	0.016	24.606
11	2	0.031	24.606
11	3	0.031	24.606
11	4	0.031	24.606
11	5	0.016	24.606
12	1	0.016	0.000
12	1	0.016	0.000
12	1	0.016	24.606
12	2	0.031	24.606
12	3	0.031	24.606
12	4	0.031	24.606
12	5	0.016	24.606
13	1	0.016	0.000
13	1	0.016	0.000
13	1	0.016	49.213
13	2	0.031	49.213
13	3	0.031	49.213
13	4	0.031	49.213
13	5	0.016	49.213

DEAD LOADS ON COMPOSITE

UNITS: (Point: kips, Location: ft, Line: klf, Trapez: klf, Area: ksf, Width: ft)

Span	DL/ADL	Type	Mag.1	Loc.1/Width	Mag.2	Loc.2	Description
1	DL	Line	0.505	0.000	0.505	49.213	Left Barrier Weight
1	DL	Line	0.505	0.000	0.505	49.213	Right Barrier Weight
1	DL	Line	0.606	0.000	0.606	49.213	Right Sidewalk
2	DL	Line	0.505	0.000	0.505	49.213	Left Barrier Weight
2	DL	Line	0.505	0.000	0.505	49.213	Right Barrier Weight
2	DL	Line	0.606	0.000	0.606	49.213	Right Sidewalk
3	DL	Line	0.505	0.000	0.505	49.213	Left Barrier Weight
3	DL	Line	0.505	0.000	0.505	49.213	Right Barrier Weight
3	DL	Line	0.606	0.000	0.606	49.213	Right Sidewalk
4	DL	Line	0.505	0.000	0.505	49.213	Left Barrier Weight
4	DL	Line	0.505	0.000	0.505	49.213	Right Barrier Weight
4	DL	Line	0.606	0.000	0.606	49.213	Right Sidewalk
5	DL	Line	0.505	0.000	0.505	49.213	Left Barrier Weight
5	DL	Line	0.505	0.000	0.505	49.213	Right Barrier Weight
5	DL	Line	0.606	0.000	0.606	49.213	Right Sidewalk
6	DL	Line	0.505	0.000	0.505	49.213	Left Barrier Weight
6	DL	Line	0.505	0.000	0.505	49.213	Right Barrier Weight
6	DL	Line	0.606	0.000	0.606	49.213	Right Sidewalk
7	DL	Line	0.505	0.000	0.505	49.213	Left Barrier Weight
7	DL	Line	0.505	0.000	0.505	49.213	Right Barrier Weight
7	DL	Line	0.606	0.000	0.606	49.213	Right Sidewalk
8	DL	Line	0.505	0.000	0.505	49.213	Left Barrier Weight
8	DL	Line	0.505	0.000	0.505	49.213	Right Barrier Weight
8	DL	Line	0.606	0.000	0.606	49.213	Right Sidewalk
9	DL	Line	0.505	0.000	0.505	49.213	Left Barrier Weight
9	DL	Line	0.505	0.000	0.505	49.213	Right Barrier Weight
9	DL	Line	0.606	0.000	0.606	49.213	Right Sidewalk
10	DL	Line	0.505	0.000	0.505	49.213	Left Barrier Weight
10	DL	Line	0.505	0.000	0.505	49.213	Right Barrier Weight
10	DL	Line	0.606	0.000	0.606	49.213	Right Sidewalk
11	DL	Line	0.505	0.000	0.505	49.213	Left Barrier Weight
11	DL	Line	0.505	0.000	0.505	49.213	Right Barrier Weight
11	DL	Line	0.606	0.000	0.606	49.213	Right Sidewalk
12	DL	Line	0.505	0.000	0.505	49.213	Left Barrier Weight
12	DL	Line	0.505	0.000	0.505	49.213	Right Barrier Weight
12	DL	Line	0.606	0.000	0.606	49.213	Right Sidewalk
13	DL	Line	0.505	0.000	0.505	49.213	Left Barrier Weight
13	DL	Line	0.505	0.000	0.505	49.213	Right Barrier Weight
13	DL	Line	0.606	0.000	0.606	49.213	Right Sidewalk

LIVE LOADS

Live load deflection: not included.

ID: H/HS25 Lane	(Type: Lane Load)
ID: HS25 Truck	(Type: Truck Load)
ID: MLC-70 Axle	(Type: Truck Load)
ID: MLC-70 Tracked	(Type: Truck Load)

Pedestrian Load: 334.52 plf

LIVE LOADS USED
LIVE LOAD LIBRARY: Default.cs4

1 ID: H/HS25 Lane

Description:	H25/HS25 as in AASHTO-STANDARD
Type:	Lane Load

Lane Load:	Intensity = 0.80 klf,	Width = 10.00 ft
Conc. Loads:	Moment = 22.50 k,	Shear = 32.50 k

2 ID: HS25 Truck

Description:	HS25 Truck as in AASHTO-STANDARD
Type:	Truck Load

Uniform Load	Intensity, klf	Location, ft	Length, ft
Preceding Load	0.00	0.00	0.00
Trailing Load	0.00	0.00	0.00

First Axle Magnitude = 10.00 k,	Wheel Spacing = 6.00 ft,	Truck Width = 10.00 ft

#	Magnitude, k	Max Spacing, ft	Min Spacing, ft	Increment, ft
1	40.00	14.00	14.00	0.00
2	40.00	30.00	14.00	2.00

3 ID: MLC-70 Axle

Description:	Military MLC-70 Axle
Type:	Truck Load

Uniform Load	Intensity, klf	Location, ft	Length, ft
Preceding Load	0.00	0.00	0.00
Trailing Load	0.00	0.00	0.00

First Axle Magnitude = 21.00 k,	Wheel Spacing = 5.74 ft,	Truck Width = 9.84 ft

#	Magnitude, k	Max Spacing, ft	Min Spacing, ft	Increment, ft
1	42.00	12.01	12.01	0.00
2	42.00	4.99	4.99	0.00
3	28.00	14.99	14.99	0.00
4	28.00	4.00	4.00	0.00

4 ID: MLC-70 Tracked

Description:	Military MLC-70 Tracked
Type:	Truck Load

Uniform Load	Intensity, klf	Location, ft	Length, ft
Preceding Load	0.00	0.00	0.00
Trailing Load	0.00	0.00	0.00

First Axle Magnitude = 4.67 k, Wheel Spacing = 5.74 ft, Truck Width = 9.84 ft

#	Magnitude, k	Max Spacing, ft	Min Spacing, ft	Increment, ft
1	9.33	1.00	1.00	0.00
2	9.33	1.00	1.00	0.00
3	9.33	1.00	1.00	0.00
4	9.33	1.00	1.00	0.00
5	9.33	1.00	1.00	0.00
6	9.33	1.00	1.00	0.00
7	9.33	1.00	1.00	0.00
8	9.33	1.00	1.00	0.00
9	9.33	1.00	1.00	0.00
10	9.33	1.00	1.00	0.00
11	9.33	1.00	1.00	0.00
12	9.33	1.00	1.00	0.00
13	9.33	1.00	1.00	0.00
14	9.33	1.00	1.00	0.00
15	4.67	1.00	1.00	0.00

RATING LOADS - NONE

ANALYSIS DATA
ANALYSIS PARAMETERS DATA

Span#	Beam#	Moment impact	Shear impact
1	1	1.287	Calculated (AASHTO 3.8.2.2)
1	2	1.287	Calculated (AASHTO 3.8.2.2)
1	3	1.287	Calculated (AASHTO 3.8.2.2)
1	4	1.287	Calculated (AASHTO 3.8.2.2)
1	5	1.287	Calculated (AASHTO 3.8.2.2)
2	1	1.287	Calculated (AASHTO 3.8.2.2)
2	2	1.287	Calculated (AASHTO 3.8.2.2)
2	3	1.287	Calculated (AASHTO 3.8.2.2)
2	4	1.287	Calculated (AASHTO 3.8.2.2)
2	5	1.287	Calculated (AASHTO 3.8.2.2)
3	1	1.287	Calculated (AASHTO 3.8.2.2)
3	2	1.287	Calculated (AASHTO 3.8.2.2)
3	3	1.287	Calculated (AASHTO 3.8.2.2)
3	4	1.287	Calculated (AASHTO 3.8.2.2)
3	5	1.287	Calculated (AASHTO 3.8.2.2)
4	1	1.287	Calculated (AASHTO 3.8.2.2)
4	2	1.287	Calculated (AASHTO 3.8.2.2)
4	3	1.287	Calculated (AASHTO 3.8.2.2)
4	4	1.287	Calculated (AASHTO 3.8.2.2)
4	5	1.287	Calculated (AASHTO 3.8.2.2)
5	1	1.287	Calculated (AASHTO 3.8.2.2)
5	2	1.287	Calculated (AASHTO 3.8.2.2)
5	3	1.287	Calculated (AASHTO 3.8.2.2)
5	4	1.287	Calculated (AASHTO 3.8.2.2)
5	5	1.287	Calculated (AASHTO 3.8.2.2)
6	1	1.287	Calculated (AASHTO 3.8.2.2)
6	2	1.287	Calculated (AASHTO 3.8.2.2)
6	3	1.287	Calculated (AASHTO 3.8.2.2)
6	4	1.287	Calculated (AASHTO 3.8.2.2)
6	5	1.287	Calculated (AASHTO 3.8.2.2)
7	1	1.287	Calculated (AASHTO 3.8.2.2)
7	2	1.287	Calculated (AASHTO 3.8.2.2)
7	3	1.287	Calculated (AASHTO 3.8.2.2)
7	4	1.287	Calculated (AASHTO 3.8.2.2)
7	5	1.287	Calculated (AASHTO 3.8.2.2)
8	1	1.287	Calculated (AASHTO 3.8.2.2)
8	2	1.287	Calculated (AASHTO 3.8.2.2)
8	3	1.287	Calculated (AASHTO 3.8.2.2)
8	4	1.287	Calculated (AASHTO 3.8.2.2)
8	5	1.287	Calculated (AASHTO 3.8.2.2)
9	1	1.287	Calculated (AASHTO 3.8.2.2)
9	2	1.287	Calculated (AASHTO 3.8.2.2)
9	3	1.287	Calculated (AASHTO 3.8.2.2)
9	4	1.287	Calculated (AASHTO 3.8.2.2)
9	5	1.287	Calculated (AASHTO 3.8.2.2)
10	1	1.287	Calculated (AASHTO 3.8.2.2)
10	2	1.287	Calculated (AASHTO 3.8.2.2)

Span#	Beam#	Moment impact	Shear impact
10	3	1.287	Calculated (AASHTO 3.8.2.2)
10	4	1.287	Calculated (AASHTO 3.8.2.2)
10	5	1.287	Calculated (AASHTO 3.8.2.2)
11	1	1.287	Calculated (AASHTO 3.8.2.2)
11	2	1.287	Calculated (AASHTO 3.8.2.2)
11	3	1.287	Calculated (AASHTO 3.8.2.2)
11	4	1.287	Calculated (AASHTO 3.8.2.2)
11	5	1.287	Calculated (AASHTO 3.8.2.2)
12	1	1.287	Calculated (AASHTO 3.8.2.2)
12	2	1.287	Calculated (AASHTO 3.8.2.2)
12	3	1.287	Calculated (AASHTO 3.8.2.2)
12	4	1.287	Calculated (AASHTO 3.8.2.2)
12	5	1.287	Calculated (AASHTO 3.8.2.2)
13	1	1.287	Calculated (AASHTO 3.8.2.2)
13	2	1.287	Calculated (AASHTO 3.8.2.2)
13	3	1.287	Calculated (AASHTO 3.8.2.2)
13	4	1.287	Calculated (AASHTO 3.8.2.2)
13	5	1.287	Calculated (AASHTO 3.8.2.2)

NOTE: Beam specific dead and live load DFs are printed in beam level reports.

GAMMA/BETA FACTORS: (Table 3.22.1A)

	Service		Factored	
Gamma:	1.00		1.30	
Beta-D:	1.00		1.00	
Beta-L:	1.00	(Group 1)	1.67	(Group 1)

PROJECT DESIGN PARAMETERS
MULTIPLIERS:

Trans len mult:	Bonded	1.00
	Debonded	1.00
Dev len mult:	Bonded	1.60
	Debonded	2.00

Camber & Deflection Multiplier (PCI ref.)

	Erection	Final
Prestress:	1.80	2.20
Self. Wt:	1.85	2.40
Deck + Haunch:		2.30
Diaphragm:		3.00
Prec.DL+ADL:		3.00
Comp.DL+ADL:		3.00

MOMENT AND SHEAR PROVISIONS:

Ultimate Moment Capacity, Mu-prvd computed:	Strain Compatibility method.
Horizontal Shear, Beam and Slab effects in Vu:	EXCLUDED

STRESS LIMITS (Art. 9.15.2):
STRESS LIMITS AT FINAL 1 (P/S + DL + LL) (Art. 9.15.2.2 a):

	PRECAST		DECK	
Strength	3988.54	psi	3988.54	psi
Max Comp, Top	2393.12	psi	2393.12	psi
Pos Mom, Bot	2393.12	psi		
Neg Mom, Bot	2393.12	psi		
Max Tens, Top	-378.93	psi	-473.66	psi
Max Tens, Bot	-378.93	psi		
Crk Tens, Bot	-473.66	psi		
Elasticity	3852.5	ksi	3852.5	ksi

STRESS LIMITS AT FINAL 2 (P/S + DL) (Art. 9.15.2.2 b):

	PRECAST		DECK	
Max Comp, Top	1595.42	psi	1595.42	psi
Pos Mom, Bot	1595.42	psi		
Neg Mom, Bot	1595.42	psi		

STRESS LIMITS AT FINAL 3 (50% P/S + 50% DL + LL) (Art. 9.15.2.2 c):

	PRECAST		DECK	
Max Comp, Top	1595.42	psi	1595.42	psi
Pos Mom, Bot	1595.42	psi		
Neg Mom, Bot	1595.42	psi		

AT RELEASE (Art. 9.15.2.1):

	PRECAST	
Strength	3988.54	psi
Max Comp, Top	2393.12	psi
Max Comp, Bot	2393.12	psi
Max Tens, Top	-189.46	psi
w/reinf	-473.66	psi
Max Tens, Bot	-0.00	psi
Elasticity	3852.5	ksi

RESISTANCE FACTORS (Art. 9.14):

Flexure Reinforced	0.90
Flexure Prestressed	1.00
Shear	0.90

PRESTRESS LOSSES:

Time Dependent Losses, Approximate Method (Art.5.9.5.3)
Hours to release = 24.00
Rel. Humid.(RH) = 75.0 %

RATING PARAMETERS
Allowable Stresses

Concrete

	Factor	Allowable Stress, psi
Tension	6.00	378.92
Compression 1	0.60	2393.12
Compression 2	0.40	1595.42

Prestressing Tendons

Tension	Factor	Allowable Stress, psi
Inventory	0.80	194400
Operating	0.90	218700

SHEAR/MOMENT ENVELOPE (&REACTIONS)

SHEAR AND MOMENT ENVELOPE : Span : 1, Beam : 2, SERVICE 1
Shears: kips, Moments: kft

		Bearing	Trans	H/2	0.10L	0.20L	0.30L	0.40L	Midspan
Location,	ft	0.00	2.08	2.42	4.92	9.84	14.76	19.69	24.61
Self wt. :	M	0.0	59.5	68.6	132.0	234.6	308.0	352.0	366.6
	V	29.8	27.3	26.9	23.8	17.9	11.9	6.0	0.0
Prec. :	M	0.0	29.4	33.9	65.2	115.9	152.1	173.9	181.1
DL+ADL	V	14.7	13.5	13.3	11.8	8.8	5.9	2.9	0.0
Deck :	M	0.0	33.9	39.1	75.2	133.7	175.5	200.6	209.0
+ Haunch	V	17.0	15.5	15.3	13.6	10.2	6.8	3.4	0.0
Diaphragm :	M	0.0	0.0	0.0	0.1	0.2	0.2	0.3	0.4
	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Comp. :	M	0.0	15.9	18.3	35.2	62.6	82.2	93.9	97.8
DL+ADL	V	8.0	7.3	7.2	6.4	4.8	3.2	1.6	0.0
LL + I :	M+	0.0	211.9	244.4	471.0	839.1	1100.3	1258.7	1310.1
	V	106.6	100.8	99.9	93.0	68.8	50.2	25.8	1.3
LL + I :	M-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LL + I :	Vmx	106.6	101.5	100.7	94.6	82.2	69.5	56.8	44.1
	M	0.0	210.9	242.9	462.6	801.4	1016.5	1107.8	1075.4
Pedestrian:	M+	0.0	3.3	3.8	7.3	13.0	17.0	19.4	20.3
	V	1.6	1.5	1.5	1.3	1.0	0.7	0.3	0.0
Pedestrian:	M-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pedestrian:	Vmx	1.6	1.5	1.5	1.3	1.1	0.8	0.6	0.4
	M	0.0	3.1	3.6	6.6	10.4	11.9	11.7	10.1
Total :	M+	0.0	353.8	408.0	786.0	1399.2	1835.4	2098.8	2185.3
	V	177.7	165.9	164.0	149.9	111.5	78.7	40.0	1.3
Total :	M-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total :	Vmx	177.7	166.6	164.9	151.5	125.0	98.2	71.3	44.6
	M	0.0	352.7	406.3	776.9	1358.9	1746.5	1940.2	1940.5

		0.60L	0.70L	0.80L	0.90L	H/2	Trans	Bearing
Location,	ft	29.53	34.45	39.37	44.29	46.79	47.13	49.21
Self wt. :	M	352.0	308.0	234.6	132.0	68.6	59.5	0.0
	V	6.0	11.9	17.9	23.8	26.9	27.3	29.8
Prec. :	M	173.9	152.1	115.9	65.2	33.9	29.4	0.0
DL+ADL	V	2.9	5.9	8.8	11.8	13.3	13.5	14.7
Deck :	M	200.6	175.5	133.7	75.2	39.1	33.9	0.0
+ Haunch	V	3.4	6.8	10.2	13.6	15.3	15.5	17.0
Diaphragm :	M	0.3	0.2	0.2	0.1	0.0	0.0	0.0
	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Comp. :	M	93.9	82.2	62.6	35.2	18.3	15.9	0.0
DL+ADL	V	1.6	3.2	4.8	6.4	7.2	7.3	8.0
LL + I :	M+	1258.7	1100.3	839.1	471.0	244.4	211.9	0.0
	V	25.8	50.2	68.8	93.0	99.9	100.8	106.6

		0.60L	0.70L	0.80L	0.90L	H/2	Trans	Bearing
LL + I :	M-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LL + I :	Vmx	56.8	69.5	82.2	94.6	100.7	101.5	106.6
	M	1107.8	1016.5	801.4	462.6	242.9	210.9	0.0
Pedestrian:	M+	19.4	17.0	13.0	7.3	3.8	3.3	0.0
	V	0.3	0.7	1.0	1.3	1.5	1.5	1.6
Pedestrian:	M-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pedestrian:	Vmx	0.6	0.8	1.1	1.3	1.5	1.5	1.6
	M	11.7	11.9	10.4	6.6	3.6	3.1	0.0
Total :	M+	2098.8	1835.4	1399.2	786.0	408.0	353.8	0.0
	V	40.0	78.7	111.5	149.9	164.0	165.9	177.7
Total :	M-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total :	Vmx	71.3	98.2	125.0	151.5	164.8	166.6	177.7
	M	1940.2	1746.5	1358.9	776.9	406.3	352.7	0.0

REACTIONS (kips), SERVICE 1

Load Type	Left Support	Right Support
Self Wt.	29.8	29.8
Deck+Haunch	17.0	17.0
Diaphragm	0.0	0.0
Prec.DL+ADL	14.7	14.7
Comp. DL+ADL	8.0	8.0
Live	106.6	106.6
Pedestrian	1.6	1.6

Upward reactions are positive.
Live Load reactions are per lane with no distribution factor and no impact.
Non-composite load types are per beam.
Composite and Pedestrian load types are per total bridge width.

SHEAR AND MOMENT ENVELOPE : Span : 1, Beam : 2, FACTORED 1
Shears: kips, Moments: kft

		Bearing	Trans	H/2	0.10L	0.20L	0.30L	0.40L	Midspan
Location,	ft	0.00	2.08	2.42	4.92	9.84	14.76	19.69	24.61
Self wt. :	M	0.0	77.3	89.1	171.6	305.0	400.4	457.6	476.6
	V	38.7	35.5	34.9	31.0	23.2	15.5	7.7	0.0
Prec. :	M	0.0	38.2	44.0	84.8	150.7	197.8	226.0	235.5
DL+ADL	V	19.1	17.5	17.3	15.3	11.5	7.7	3.8	0.0
Deck :	M	0.0	44.1	50.8	97.8	173.9	228.2	260.8	271.7
+ Haunch	V	22.1	20.2	19.9	17.7	13.2	8.8	4.4	0.0

Bentley			Sheet #	DS-22
			Job #	
Program:	LEAP® CONSPAN® V8i (SELECTseries 2)	EAS-RAI-USA	Designed By	
Version:	10.00.01.20	Copyright © Bentley Systems, Inc. 1984 - 2011	Date	Sept/12/2011
		www.bentley.com Phone: 1-800-778-4277	Checked	SAM
File Name:	Khost_SS_600x1250.csl		Date	9/26/11

		Bearing	Trans	H/2	0.10L	0.20L	0.30L	0.40L	Midspan
Diaphragm :	M	0.0	0.0	0.0	0.1	0.2	0.3	0.4	0.5
	V	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Comp. :	M	0.0	20.6	23.8	45.8	81.4	106.8	122.1	127.2
DL+ADL	V	10.3	9.5	9.3	8.3	6.2	4.1	2.1	0.0
LL + I :	M+	0.0	460.1	530.6	1022.4	1821.7	2388.7	2732.6	2844.2
	V	231.4	218.9	216.9	201.8	149.4	109.1	55.9	2.8
LL + I :	M-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LL + I :	Vmx	231.4	220.4	218.6	205.4	178.6	151.0	123.4	95.8
	M	0.0	457.9	527.3	1004.2	1739.8	2206.8	2405.0	2334.6
Pedestrian:	M+	0.0	7.1	8.2	15.8	28.1	36.9	42.2	44.0
	V	3.6	3.3	3.2	2.9	2.1	1.4	0.7	0.0
Pedestrian:	M-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pedestrian:	Vmx	3.6	3.3	3.2	2.9	2.3	1.8	1.3	0.9
	M	0.0	6.8	7.8	14.2	22.5	25.9	25.3	22.0
Total :	M+	0.0	647.4	746.6	1438.3	2561.1	3359.2	3841.7	3999.6
	V	325.3	304.9	301.6	276.9	205.7	146.6	74.7	2.8
Total :	M-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total :	Vmx	325.3	306.4	303.3	280.5	235.0	188.9	142.8	96.8
	M	0.0	644.9	742.9	1418.5	2473.6	3166.1	3497.3	3468.1

		0.60L	0.70L	0.80L	0.90L	H/2	Trans	Bearing
Location,	ft	29.53	34.45	39.37	44.29	46.79	47.13	49.21
Self wt. :	M	457.6	400.4	305.0	171.6	89.1	77.3	0.0
	V	7.7	15.5	23.2	31.0	34.9	35.5	38.7
Prec. :	M	226.0	197.8	150.7	84.8	44.0	38.2	0.0
DL+ADL	V	3.8	7.7	11.5	15.3	17.3	17.5	19.1
Deck :	M	260.8	228.2	173.9	97.8	50.8	44.1	0.0
+ Haunch	V	4.4	8.8	13.2	17.7	19.9	20.2	22.1
Diaphragm :	M	0.4	0.3	0.2	0.1	0.0	0.0	0.0
	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Comp. :	M	122.1	106.8	81.4	45.8	23.8	20.6	0.0
DL+ADL	V	2.1	4.1	6.2	8.3	9.3	9.5	10.3
LL + I :	M+	2732.6	2388.7	1821.7	1022.4	530.6	460.1	0.0
	V	55.9	109.1	149.4	201.8	216.9	218.9	231.4
LL + I :	M-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LL + I :	Vmx	123.4	151.0	178.6	205.4	218.6	220.4	231.4
	M	2405.0	2206.8	1739.8	1004.2	527.3	457.9	0.0
Pedestrian:	M+	42.2	36.9	28.1	15.8	8.2	7.1	0.0
	V	0.7	1.4	2.1	2.9	3.2	3.3	3.6
Pedestrian:	M-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pedestrian:	Vmx	1.3	1.8	2.3	2.9	3.2	3.3	3.6
	M	25.3	25.9	22.5	14.2	7.8	6.8	0.0
Total :	M+	3841.7	3359.2	2561.1	1438.3	746.6	647.4	0.0
	V	74.7	146.6	205.7	276.9	301.5	304.8	325.3
Total :	M-	0.0	0.0	0.0	0.0	0.0	0.0	0.0

		0.60L	0.70L	0.80L	0.90L	H/2	Trans	Bearing
Total :	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Vmx	142.8	188.9	235.0	280.5	303.3	306.4	325.3
	M	3497.3	3166.1	2473.6	1418.5	742.9	644.9	0.0

REACTIONS (kips), FACTORED 1

Load Type	Left Support	Right Support
Self Wt.	38.7	38.7
Deck+Haunch	22.1	22.1
Diaphragm	0.1	0.0
Prec.DL+ADL	19.1	19.1
Comp. DL+ADL	10.3	10.3
Live	231.4	231.4
Pedestrian	3.6	3.6

Upward reactions are positive.
Live Load reactions are per lane with no distribution factor and no impact.
Non-composite load types are per beam.
Composite and Pedestrian load types are per total bridge width.

CAMBER/DEFLECTION

CAMBER AND DEFLECTIONS: SERVICE 1
(Span : 1, Beam : 2; Units: in)

	Release	Mult	Erection	Mult	Final
At 0.1 x L =	4.92 ft				
Prestress	-0.006	1.80	-0.010	2.20	-0.013
Self Wt.	-0.056	1.85	-0.103	2.40	-0.133
Deck + Haunch			-0.032	2.30	-0.073
Prec. DL+ADL			-0.027	3.00	-0.082
Diaphragm			-0.000	3.00	-0.000
Comp. DL+ADL			-0.006	3.00	-0.018
Live Load(+I)					-0.069
Pedestrian Load					-0.000
Total	-0.061		-0.178		-0.388

	Release	Mult	Erection	Mult	Final
At 0.2 x L =	9.84 ft				
Prestress	-0.010	1.80	-0.018	2.20	-0.022
Self Wt.	-0.105	1.85	-0.194	2.40	-0.252
Deck + Haunch			-0.060	2.30	-0.138
Prec. DL+ADL			-0.052	3.00	-0.156
Diaphragm			-0.000	3.00	-0.000
Comp. DL+ADL			-0.011	3.00	-0.033
Live Load(+I)					-0.131
Pedestrian Load					-0.000
Total	-0.115		-0.335		-0.733

	Release	Mult	Erection	Mult	Final
At 0.3 x L =	14.76 ft				
Prestress	-0.013	1.80	-0.024	2.20	-0.029
Self Wt.	-0.144	1.85	-0.266	2.40	-0.345
Deck + Haunch			-0.082	2.30	-0.188
Prec. DL+ADL			-0.071	3.00	-0.213
Diaphragm			-0.000	3.00	-0.000
Comp. DL+ADL			-0.015	3.00	-0.045
Live Load(+I)					-0.182
Pedestrian Load					-0.001
Total	-0.157		-0.458		-1.004

	Release	Mult	Erection	Mult	Final
At 0.4 x L =	19.69 ft				
Prestress	-0.015	1.80	-0.027	2.20	-0.033
Self Wt.	-0.168	1.85	-0.312	2.40	-0.404
Deck + Haunch			-0.096	2.30	-0.221
Prec. DL+ADL			-0.083	3.00	-0.250
Diaphragm			-0.000	3.00	-0.000
Comp. DL+ADL			-0.018	3.00	-0.053

	Release	Mult	Erection	Mult	Final
Live Load(+I)					-0.214
Pedestrian Load					-0.001
Total	-0.184		-0.536		-1.176

	Release	Mult	Erection	Mult	Final
At 0.5 x L =	24.61 ft				
Prestress	-0.016	1.80	-0.029	2.20	-0.035
Self Wt.	-0.177	1.85	-0.327	2.40	-0.424
Deck + Haunch			-0.101	2.30	-0.232
Prec. DL+ADL			-0.087	3.00	-0.262
Diaphragm			-0.000	3.00	-0.000
Comp. DL+ADL			-0.019	3.00	-0.056
Live Load(+I)					-0.225
Pedestrian Load					-0.001
Total	-0.193		-0.563		-1.235

	Release	Mult	Erection	Mult	Final
At 0.6 x L =	29.53 ft				
Prestress	-0.015	1.80	-0.027	2.20	-0.033
Self Wt.	-0.168	1.85	-0.312	2.40	-0.404
Deck + Haunch			-0.096	2.30	-0.221
Prec. DL+ADL			-0.083	3.00	-0.250
Diaphragm			-0.000	3.00	-0.000
Comp. DL+ADL			-0.018	3.00	-0.053
Live Load(+I)					-0.214
Pedestrian Load					-0.001
Total	-0.184		-0.536		-1.176

	Release	Mult	Erection	Mult	Final
At 0.7 x L =	34.45 ft				
Prestress	-0.013	1.80	-0.024	2.20	-0.029
Self Wt.	-0.144	1.85	-0.266	2.40	-0.345
Deck + Haunch			-0.082	2.30	-0.188
Prec. DL+ADL			-0.071	3.00	-0.213
Diaphragm			-0.000	3.00	-0.000
Comp. DL+ADL			-0.015	3.00	-0.045
Live Load(+I)					-0.182
Pedestrian Load					-0.001
Total	-0.157		-0.458		-1.004

	Release	Mult	Erection	Mult	Final
At 0.8 x L =	39.37 ft				
Prestress	-0.010	1.80	-0.018	2.20	-0.022
Self Wt.	-0.105	1.85	-0.194	2.40	-0.252
Deck + Haunch			-0.060	2.30	-0.138
Prec. DL+ADL			-0.052	3.00	-0.156
Diaphragm			-0.000	3.00	-0.000
Comp. DL+ADL			-0.011	3.00	-0.033
Live Load(+I)					-0.131

	Release	Mult	Erection	Mult	Final
Pedestrian Load					-0.000
Total	-0.115		-0.335		-0.733

	Release	Mult	Erection	Mult	Final
At 0.9 x L =	44.29 ft				
Prestress	-0.006	1.80	-0.010	2.20	-0.013
Self Wt.	-0.056	1.85	-0.103	2.40	-0.133
Deck + Haunch			-0.032	2.30	-0.073
Prec. DL+ADL			-0.027	3.00	-0.082
Diaphragm			-0.000	3.00	-0.000
Comp. DL+ADL			-0.006	3.00	-0.018
Live Load(+I)					-0.069
Pedestrian Load					-0.000
Total	-0.061		-0.178		-0.388

Positive values indicate upward deflection.

CONSPAN RESULTS

FOR VARIES LIVE LOAD CASES

& BACKUP CALCULATIONS

THIS PAGE INTENTIONALLY LEFT BLANK

CONSPAN RESULTS

All Vehicles (Truck & Lane)

SHEAR & MOMENT ENVELOPE: SPAN 1, BEAM 2, SERVICE 1																	
SHEAR: KIPS MOMENTS: KIP-FT																	
Location		Bearing	Trans.	H/2	0.10L	0.20L	0.30L	0.40L	MidSpan	0.60L	0.70L	0.80L	0.90L	H/2	Trans.	Bearing
	Ft	0.00	2.08	2.42	4.92	9.84	14.76	19.69	24.61	29.53	34.45	39.37	44.29	46.79	47.13	49.21
Self Weight	M	0.00	59.50	68.60	132.00	234.60	308.00	352.00	366.60	352.00	308.00	234.60	132.00	68.60	59.50	0.00
	V	29.80	27.30	26.90	23.80	17.90	11.90	6.00	0.00	6.00	11.90	17.90	23.80	26.90	27.30	29.80
Prec. DL+ADL	M	0.00	29.40	33.90	65.20	115.90	152.10	173.90	181.10	173.90	152.10	115.90	65.20	33.90	29.40	0.00
	V	14.70	13.50	13.30	11.80	8.80	5.90	2.90	0.00	2.90	5.90	8.80	11.80	13.30	13.50	14.70
Deck + Haunch	M	0.00	33.90	39.10	75.20	133.70	175.50	200.60	209.00	200.60	175.50	133.70	75.20	39.10	33.90	0.00
	V	17.00	15.50	15.30	13.60	10.20	6.80	3.40	0.00	3.40	6.80	10.20	13.60	15.30	15.50	17.00
Diaphragm	M	0.00	0.00	0.00	0.10	0.20	0.20	0.30	0.40	0.30	0.20	0.20	0.10	0.00	0.00	0.00
	V	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Comp. DL+ADL	M	0.00	15.90	18.30	35.20	62.60	82.20	93.90	97.80	93.90	82.20	62.60	35.20	18.30	15.90	0.00
	V	8.00	7.30	7.20	6.40	4.80	3.20	1.60	0.00	1.60	3.20	4.80	6.40	7.20	7.30	8.00
LL + I	M+	0.00	211.90	244.40	471.00	839.10	1100.30	1258.70	1310.10	1258.70	1100.30	839.10	471.00	244.40	211.90	0.00
	V	106.60	100.80	99.90	93.00	68.80	50.20	25.80	1.30	25.80	50.20	68.80	93.00	99.90	100.80	106.60
	M-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	V	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Vmax	106.60	101.50	100.70	94.60	82.20	69.50	56.80	44.10	56.80	69.50	82.20	94.60	100.70	101.50	106.60
	M	0.00	210.90	242.90	462.60	801.40	1016.50	1107.80	1075.40	1107.80	1016.50	801.40	462.60	242.90	210.90	0.00
Pedestrian	M+	0.00	3.30	3.80	7.30	13.00	17.00	19.40	20.30	19.40	17.00	13.00	7.30	3.80	3.30	0.00
	V	1.60	1.50	1.50	1.30	1.00	0.70	0.30	0.00	0.30	0.70	1.00	1.30	1.50	1.50	1.60
	M-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	V	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Vmax	1.60	1.50	1.50	1.30	1.10	0.80	0.60	0.40	0.60	0.80	1.10	1.30	1.50	1.50	1.60
	M	0.00	3.10	3.60	6.60	10.40	11.90	11.70	10.10	11.70	11.90	10.40	6.60	3.60	3.10	0.00

	Bearing Shear	
	kips	kN
Self Weight =	29.80	132.55
Prec. DL+ADL =	14.70	65.39
Deck + Haunch =	17.00	75.62
Diaphragm =	0.00	0.00
Comp. DL+ADL =	8.00	35.58
V_DL =	69.50	309.14
LL + I =	106.60	474.16
Pedestrian =	1.60	7.12
V_LL =	108.20	481.27

	MidSpan Moment	
	k-ft	kN-m
Self Weight =	352.00	477.25
Prec. DL+ADL =	173.90	235.78
Deck + Haunch =	200.60	271.98
Diaphragm =	0.30	0.41
Comp. DL+ADL =	93.90	127.31
M_LL =	820.70	1112.72
LL + I =	1258.70	1706.57
Pedestrian =	19.40	26.30
M_LL =	1278.10	1732.87

V_DL =	69.50	309.14
V_LL =	108.20	481.27
V =	177.70	790.41

M_DL =	820.70	1112.72
M_LL =	1278.10	1732.87
M =	2098.80	2845.60

DL Factor =	1.30	1.30
LL Factor =	1.67	1.67
Vu_DL =	90.35	401.88
Vu_LL =	180.69	803.73
Vu =	271.04	1205.60

DL Factor =	1.30	1.30
LL Factor =	1.67	1.67
Mu_DL =	1066.91	1446.54
Mu_LL =	2134.43	2893.90
Mu =	3201.34	4340.44

checked by: SAM

CONSPAN RESULTS

All Vehicles (Truck & Lane)

SHEAR & MOMENT ENVELOPE: SPAN 1, BEAM 2, SERVICE 1															
SHEAR: KIPS MOMENTS: KIP-FT															
	Bearing	Trans.	H/2	0.10L	0.20L	0.30L	0.40L	MidSpan	0.60L	0.70L	0.80L	0.90L	H/2	Trans.	Bearing
Location (ft)	0	2.08	2.42	4.92	9.84	14.76	19.69	24.61	29.53	34.45	39.37	44.29	46.79	47.13	49.21
Self wt. :M	0	59.5	68.6	132	234.6	308	352	366.6	352	308	234.6	132	68.6	59.5	0
Self wt. :V	29.8	27.3	26.9	23.8	17.9	11.9	6	0	6	11.9	17.9	23.8	26.9	27.3	29.8
Prec. :M	0	29.4	33.9	65.2	115.9	152.1	173.9	181.1	173.9	152.1	115.9	65.2	33.9	29.4	0
DL+ADL :V	14.7	13.5	13.3	11.8	8.8	5.9	2.9	0	2.9	5.9	8.8	11.8	13.3	13.5	14.7
Deck :M	0	33.9	39.1	75.2	133.7	175.5	200.6	209	200.6	175.5	133.7	75.2	39.1	33.9	0
+Haunch: V	17	15.5	15.3	13.6	10.2	6.8	3.4	0	3.4	6.8	10.2	13.6	15.3	15.5	17
Diaphragm: M	0	0	0	0.1	0.2	0.2	0.3	0.4	0.3	0.2	0.2	0.1	0	0	0
Diaphragm: V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Comp :M	0	15.9	18.3	35.2	62.6	82.2	93.9	97.8	93.9	82.2	62.6	35.2	18.3	15.9	0
DL+ADL :V	8	7.3	7.2	6.4	4.8	3.2	1.6	0	1.6	3.2	4.8	6.4	7.2	7.3	8
LL + I :M+	0	211.9	244.4	471	839.1	1100.3	1258.7	1310.1	1258.7	1100.3	839.1	471	244.4	211.9	0
LL + I :V	106.6	100.8	99.9	93	68.8	50.2	25.8	1.3	25.8	50.2	68.8	93	99.9	100.8	106.6
LL + I :M-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LL + I :V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LL + I :Vmax	106.6	101.5	100.7	94.6	82.2	69.5	56.8	44.1	56.8	69.5	82.2	94.6	100.7	101.5	106.6
LL + I :M	0	210.9	242.9	462.6	801.4	1016.5	1107.8	1075.4	1107.8	1016.5	801.4	462.6	242.9	210.9	0
Pedestrian :M+	0	3.3	3.8	7.3	13	17	19.4	20.3	19.4	17	13	7.3	3.8	3.3	0
Pedestrian :V	1.6	1.5	1.5	1.3	1	0.7	0.3	0	0.3	0.7	1	1.3	1.5	1.5	1.6
Pedestrian :M-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrian :V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrian :Vmax	1.6	1.5	1.5	1.3	1.1	0.8	0.6	0.4	0.6	0.8	1.1	1.3	1.5	1.5	1.6
Pedestrian :M	0	3.1	3.6	6.6	10.4	11.9	11.7	10.1	11.7	11.9	10.4	6.6	3.6	3.1	0

Checked by: SAM

MLC Axle (Truck)

SHEAR & MOMENT ENVELOPE: SPAN 1, BEAM 2, SERVICE 1															
SHEAR: KIPS MOMENTS: KIP-FT															
	Bearing	Trans.	H/2	0.10L	0.20L	0.30L	0.40L	MidSpan	0.60L	0.70L	0.80L	0.90L	H/2	Trans.	Bearing
Location (ft)	0	2.08	2.42	4.92	9.84	14.76	19.69	24.61	29.53	34.45	39.37	44.29	46.79	47.13	49.21
Self wt. :M	0	59.5	68.6	132	234.6	308	352	366.6	352	308	234.6	132	68.6	59.5	0
Self wt. :V	29.8	27.3	26.9	23.8	17.9	11.9	6	0	6	11.9	17.9	23.8	26.9	27.3	29.8
Prec. :M	0	29.4	33.9	65.2	115.9	152.1	173.9	181.1	173.9	152.1	115.9	65.2	33.9	29.4	0
DL+ADL. :V	14.7	13.5	13.3	11.8	8.8	5.9	2.9	0	2.9	5.9	8.8	11.8	13.3	13.5	14.7
Deck :M	0	33.9	39.1	75.2	133.7	175.5	200.6	209	200.6	175.5	133.7	75.2	39.1	33.9	0
+Haunch: V	17	15.5	15.3	13.6	10.2	6.8	3.4	0	3.4	6.8	10.2	13.6	15.3	15.5	17
Diaphragm: M	0	0	0	0.1	0.2	0.2	0.3	0.4	0.3	0.2	0.2	0.1	0	0	0
Diaphragm: V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Comp :M	0	15.9	18.3	35.2	62.6	82.2	93.9	97.8	93.9	82.2	62.6	35.2	18.3	15.9	0
DL+ADL :V	8	7.3	7.2	6.4	4.8	3.2	1.6	0	1.6	3.2	4.8	6.4	7.2	7.3	8
LL + I :M+	0	196.1	225.7	427.6	731.4	947.8	1060.9	1097.4	1060.9	947.8	731.4	427.6	225.7	196.1	0
LL + I :V	99.5	94.4	93.6	87.4	75.1	61.3	23.4	29.3	23.4	61.3	75.1	87.4	93.6	94.4	99.5
LL + I :M-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LL + I :V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LL + I :Vmax	99.5	94.4	93.6	87.4	75.1	61.3	46.7	32.1	46.7	61.3	75.1	87.4	93.6	94.4	99.5
LL + I :M	0	196.1	225.7	427.6	731.4	947.8	1054.6	1019	1054.6	947.8	731.4	427.6	225.7	196.1	0
Pedestrian :M+	0	3.3	3.8	7.3	13	17	19.4	20.3	19.4	17	13	7.3	3.8	3.3	0
Pedestrian :V	1.6	1.5	1.5	1.3	1	0.7	0.3	0	0.3	0.7	1	1.3	1.5	1.5	1.6
Pedestrian :M-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrian :V	1.6	0.9	0.8	0	0	0	0	0	0	0	0	0	0.8	0.9	1.6
Pedestrian :Vmax	1.6	1.5	1.5	1.3	1.1	0.8	0.6	0.4	0.6	0.8	1.1	1.3	1.5	1.5	1.6
Pedestrian :M	0	3.1	3.6	6.6	10.4	11.9	11.7	10.1	11.7	11.9	10.4	6.6	3.6	3.1	0

Checked by: SAM

MLC-70 (Tracked) Truck

SHEAR & MOMENT ENVELOPE: SPAN 1, BEAM 2, SERVICE 1															
SHEAR: KIPS MOMENTS: KIP-FT															
	Bearing	Trans.	H/2	0.10L	0.20L	0.30L	0.40L	MidSpan	0.60L	0.70L	0.80L	0.90L	H/2	Trans.	Bearing
Location (ft)	0	2.08	2.42	4.92	9.84	14.76	19.69	24.61	29.53	34.45	39.37	44.29	46.79	47.13	49.21
Self wt. :M	0	59.5	68.6	132	234.6	308	352	366.6	352	308	234.6	132	68.6	59.5	0
Self wt. :V	29.8	27.3	26.9	23.8	17.9	11.9	6	0	6	11.9	17.9	23.8	26.9	27.3	29.8
Prec. :M	0	29.4	33.9	65.2	115.9	152.1	173.9	181.1	173.9	152.1	115.9	65.2	33.9	29.4	0
DL+ADL :V	14.7	13.5	13.3	11.8	8.8	5.9	2.9	0	2.9	5.9	8.8	11.8	13.3	13.5	14.7
Deck :M	0	33.9	39.1	75.2	133.7	175.5	200.6	209	200.6	175.5	133.7	75.2	39.1	33.9	0
+Haunch: V	17	15.5	15.3	13.6	10.2	6.8	3.4	0	3.4	6.8	10.2	13.6	15.3	15.5	17
Diaphragm: M	0	0	0	0.1	0.2	0.2	0.3	0.4	0.3	0.2	0.2	0.1	0	0	0
Diaphragm: V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Comp :M	0	15.9	18.3	35.2	62.6	82.2	93.9	97.8	93.9	82.2	62.6	35.2	18.3	15.9	0
DL+ADL :V	8	7.3	7.2	6.4	4.8	3.2	1.6	0	1.6	3.2	4.8	6.4	7.2	7.3	8
LL + I :M+	0	211.9	244.4	471	839.1	1100.3	1258.7	1310.1	1258.7	1100.3	839.1	471	244.4	211.9	0
LL + I :V	106.6	100.8	99.9	93	68.8	50.2	25.8	1.3	25.8	50.2	68.8	93	99.9	100.8	106.6
LL + I :M-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LL + I :V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LL + I :Vmax	106.6	101.5	100.7	94.6	82.2	69.5	56.8	44.1	56.8	69.5	82.2	94.6	100.7	101.5	106.6
LL + I :M	0	210.9	242.9	462.6	801.4	1016.5	1107.8	1075.4	1107.8	1016.5	801.4	462.6	242.9	210.9	0
Pedestrian :M+	0	3.3	3.8	7.3	13	17	19.4	20.3	19.4	17	13	7.3	3.8	3.3	0
Pedestrian :V	1.6	1.5	1.5	1.3	1	0.7	0.3	0	0.3	0.7	1	1.3	1.5	1.5	1.6
Pedestrian :M-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrian :V	1.6	0.9	0.8	0	0	0	0	0	0	0	0	0	0.8	0.9	1.6
Pedestrian :Vmax	1.6	1.5	1.5	1.3	1.1	0.8	0.6	0.4	0.6	0.8	1.1	1.3	1.5	1.5	1.6
Pedestrian :M	0	3.1	3.6	6.6	10.4	11.9	11.7	10.1	11.7	11.9	10.4	6.6	3.6	3.1	0

Checked by: SAH

HS-25 Truck

SHEAR & MOMENT ENVELOPE: SPAN 1, BEAM 2, SERVICE 1															
SHEAR: KIPS MOMENTS: KIP-FT															
	Bearing	Trans.	H/2	0.10L	0.20L	0.30L	0.40L	MidSpan	0.60L	0.70L	0.80L	0.90L	H/2	Trans.	Bearing
Location (ft)	0	2.08	2.42	4.92	9.84	14.76	19.69	24.61	29.53	34.45	39.37	44.29	46.79	47.13	49.21
Self wt. :M	0	59.5	68.6	132	234.6	308	352	366.6	352	308	234.6	132	68.6	59.5	0
Self wt. :V	29.8	27.3	26.9	23.8	17.9	11.9	6	0	6	11.9	17.9	23.8	26.9	27.3	29.8
Prec. :M	0	29.4	33.9	65.2	115.9	152.1	173.9	181.1	173.9	152.1	115.9	65.2	33.9	29.4	0
DL+ADL. :V	14.7	13.5	13.3	11.8	8.8	5.9	2.9	0	2.9	5.9	8.8	11.8	13.3	13.5	14.7
Deck :M	0	33.9	39.1	75.2	133.7	175.5	200.6	209	200.6	175.5	133.7	75.2	39.1	33.9	0
+Haunch: V	17	15.5	15.3	13.6	10.2	6.8	3.4	0	3.4	6.8	10.2	13.6	15.3	15.5	17
Diaphragm: M	0	0	0	0.1	0.2	0.2	0.3	0.4	0.3	0.2	0.2	0.1	0	0	0
Diaphragm: V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Comp :M	0	15.9	18.3	35.2	62.6	82.2	93.9	97.8	93.9	82.2	62.6	35.2	18.3	15.9	0
DL+ADL :V	8	7.3	7.2	6.4	4.8	3.2	1.6	0	1.6	3.2	4.8	6.4	7.2	7.3	8
LL + I :M+	0	129.3	148.9	282.6	485.6	609.1	678.1	680.2	678.1	609.1	485.6	282.6	148.9	129.3	0
LL + I :V	65.5	62.3	61.7	57.8	49.8	41.7	32.2	12.3	32.2	41.7	49.8	57.8	61.7	62.3	65.5
LL + I :M-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LL + I :V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LL + I :Vmax	65.5	62.3	61.7	57.8	49.8	41.7	33.5	26	33.5	41.7	49.8	57.8	61.7	62.3	65.5
LL + I :M	0	129.3	148.9	282.6	485.6	609.1	653	632.6	653	609.1	485.6	282.6	148.9	129.3	0
Pedestrian :M+	0	3.3	3.8	7.3	13	17	19.4	20.3	19.4	17	13	7.3	3.8	3.3	0
Pedestrian :V	1.6	1.5	1.5	1.3	1	0.7	0.3	0	0.3	0.7	1	1.3	1.5	1.5	1.6
Pedestrian :M-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrian :V	1.6	0.9	0.8	0	0	0	0	0	0	0	0	0	0.8	0.9	1.6
Pedestrian :Vmax	1.6	1.5	1.5	1.3	1.1	0.8	0.6	0.4	0.6	0.8	1.1	1.3	1.5	1.5	1.6
Pedestrian :M	0	3.1	3.6	6.6	10.4	11.9	11.7	10.1	11.7	11.9	10.4	6.6	3.6	3.1	0

Checked by: SAM

All Vehicles DF=1

*Used only to determine Lane Loading for Pier & Abutment Design

* The LL includes Impact

SHEAR & MOMENT ENVELOPE: SPAN 1, BEAM 2, SERVICE 1															
SHEAR: KIPS MOMENTS: KIP-FT															
	Bearing	Trans.	H/2	0.10L	0.20L	0.30L	0.40L	MidSpan	0.60L	0.70L	0.80L	0.90L	H/2	Trans.	Bearing
Location (ft)	0	2.08	2.42	4.92	9.84	14.76	19.69	24.61	29.53	34.45	39.37	44.29	46.79	47.13	49.21
Self wt. :M	0	59.5	68.6	132	234.6	308	352	366.6	352	308	234.6	132	68.6	59.5	0
Self wt. :V	29.8	27.3	26.9	23.8	17.9	11.9	6	0	6	11.9	17.9	23.8	26.9	27.3	29.8
Prec. :M	0	29.4	33.9	65.2	115.9	152.1	173.9	181.1	173.9	152.1	115.9	65.2	33.9	29.4	0
DL+ADL :V	14.7	13.5	13.3	11.8	8.8	5.9	2.9	0	2.9	5.9	8.8	11.8	13.3	13.5	14.7
Deck :M	0	33.9	39.1	75.2	133.7	175.5	200.6	209	200.6	175.5	133.7	75.2	39.1	33.9	0
+Haunch: V	17	15.5	15.3	13.6	10.2	6.8	3.4	0	3.4	6.8	10.2	13.6	15.3	15.5	17
Diaphragm: M	0	0	0	0.1	0.2	0.2	0.3	0.4	0.3	0.2	0.2	0.1	0	0	0
Diaphragm: V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Comp :M	0	15.9	18.3	35.2	62.6	82.2	93.9	97.8	93.9	82.2	62.6	35.2	18.3	15.9	0
DL+ADL :V	8	7.3	7.2	6.4	4.8	3.2	1.6	0	1.6	3.2	4.8	6.4	7.2	7.3	8
LL + I :M+	0	303.7	350.2	674.8	1202.4	1576.6	1803.5	1877.2	1803.5	1576.6	1202.4	674.8	350.2	303.7	0
LL + I :V	152.7	144.5	143.1	133.2	98.6	72	36.9	1.8	36.9	72	98.6	133.2	143.1	144.5	152.7
LL + I :M-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LL + I :V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LL + I :Vmax	152.7	145.5	144.3	135.6	117.8	99.6	81.5	63.3	81.5	99.6	117.8	135.6	144.3	145.5	152.7
LL + I :M	0	302.2	348	662.8	1148.3	1456.5	1587.3	1540.9	1587.3	1456.5	1148.3	662.8	348	302.2	0
Pedestrian :M+	0	16.4	18.9	36.5	64.8	85.1	97.2	101.3	97.2	85.1	64.8	36.5	18.9	16.4	0
Pedestrian :V	8.2	7.5	7.4	6.6	4.9	3.3	1.6	0	1.6	3.3	4.9	6.6	7.4	7.5	8.2
Pedestrian :M-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrian :V	8.2	4.7	4.2	0	0	0	0	0	0	0	0	0	4.2	4.7	8.2
Pedestrian :Vmax	8.2	7.6	7.5	6.7	5.3	4	3	2.1	3	4	5.3	6.7	7.5	7.6	8.2
Pedestrian :M	0	15.6	17.9	32.8	51.9	59.5	58.3	50.6	58.3	59.5	51.9	32.8	17.9	15.6	0

Checked by: SAM

REINFORCED CONCRETE BEAM

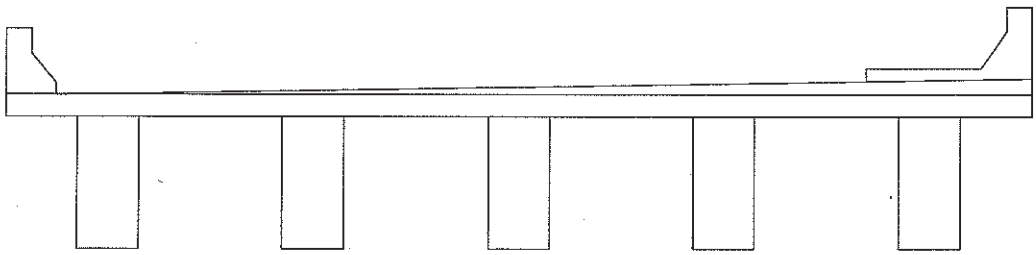
Simple Span - Hinges

Bridge Geometry

Length

Estimated Bridge Length, Le =	639.6	ft	195	m
No of Spans, Ns =	13		13	
Span Length, Ls =	50	ft	15	m
Actual Bridge Length, L =	650	ft	198	m

Cross Section



Cross Section Slope =	2%			
Bridge Width, W =	31.16	ft	9.50	m
Width of Lane(s), Wl =	12.14	ft	3.70	m
Number of Lanes, Nl =	2.00		2.00	
Width curb to curb, Wcc =	24.27	ft	7.40	m
Width of Sidewalk, Wsw =	3.94	ft	1.20	m
Width of Barrier/Railing, Wb =	1.48	ft	0.45	m
Width edge of slab to curb, Wcb =	5.41	ft	0.45	m
Width overhang, Woh =	2.13	ft	0.65	m

Height/Thickness

Concrete Slab thickness, ts =	8.86	in	0.74	ft	225	mm
Concrete Wearing Surface Thickness, tws_min =	0.00	in	0.00	ft	0	mm
Concrete Wearing Surface Thickness, tws_max =	7.13	in	0.59	ft	181	mm
Total Thickness, tt_min =	8.86	in	0.74	ft	225	mm
Total Thickness, tt_max =	17.72	in	1.48	ft	406.000	mm
tt_avg =	13.29	in	1.11	ft	315.50	mm
DL (full deck) =	3.45	klf	50.01	kN/m		
DL (sloped deck) =	1.73	klf	25.00	kN/m		
Total DL_deck =	5.18	klf	75.01	kN/m		

Checked by: SAM

Diaphragm Locations

Span	Location ft	Location m
1	0	0
1	24.6	7.5
2	24.6	7.5
3	24.6	7.5
4	24.6	7.5
5	24.6	7.5
6	24.6	7.5
7	24.6	7.5

Hinge	Location ft	Location m
8	24.6	7.5
9	24.6	7.5
10	24.6	7.5
11	24.6	7.5
12	24.6	7.5
13	24.6	7.5
13	49.2	15

Materials

1 ksi =	6.894757	Mpa
1 pcf =	16.0185	kg/m^3

f'c =	4	ksi	27.6	MPa
Fy =	60	ksi	413.7	MPa
γconc =	150	pcf	2402.775	kg/m^3
γsteel =	495	pcf	7929.1575	kg/m^3
γsoil =	118	pcf	1890.183	kg/m^3
Ec =	3852.5	ksi	26562.3	MPa
Es =	29007.5	ksi	200000.0	MPa

Checked by: SAM

Bridge Barrier & Sidewalk

Sidewalk Loading (AASHTO 3.14.1)

1 psf =	0.0479	kN/m^2

Sidewalk Loading =	85	psf	4.07	kN/m^2		
Width of Sidewalk =	3.94	ft	1.20	m		
Sidewalk Load per LF =	334.56	plf	4.88	kN/m	4882.5	N/m

Sidewalk

Sidewalk Width =	3.94	ft	47.232	in	1200	mm
Sidewalk + Barrier/Railing Width =	5.41	ft	64.944	in	1650	mm
Sidewalk Height, Hsw_max =	0.66	ft	7.872	in	200	mm
Sidewalk Height, Hsw_min =	0.59	ft	7.04544	in	179	mm
Sidewalk Height, Hsw_avg =	0.62	ft	7.45872	in	189	mm

Total Weight of Sidewalk =	504.6	lb/ft	7.31	kN/m

Concrete Barrier

1 plf =	0.0145	kN/m

Total Height =	3.44	ft	41.33	in	1050	mm
Height of Full Width =	0.66	ft	7.87	in	200	mm
Full Width (@ Bottom) =	1.48	ft	17.71	in	450	mm
Width (@ Top) =	0.98	ft	11.81	in	300	mm

Weight of Concrete Barrier /Side=	659.62	lb/ft	Conspan Input -->	9.56	kN/m
Weight of Concrete Barrier =	1319.25	lb/ft		19.12	kN/m

Steel Railing

Steel (Reference MASSDOT S3-TL4)

Total Height =	0	ft	0	in
Weight of Steel Railing / Side =	0	lb/ft		
Total Weight of Steel Railing =	0	lb/ft		

Stay in Place Forms

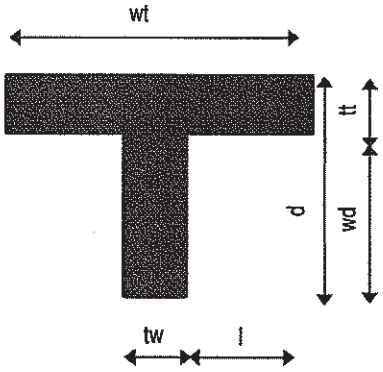
Stay in Place forms =	10.00	psf	0.479	kN/m^2
Length of Form / Beam =	4.3	ft	1.300	m
Stay in Place Forms =	42.6	plf	0.622	kN/m

Checked by: SAM

Beam Properties

General

No of Beams, Nb =	5			
Beam Spacing, Sb =	6.23	ft	1.90	m
Clear Spacing Between Beams =	4.26	ft	1.30	m
Cl of Beam to Edge =	3.12	ft	0.95	m
Overhang Width, Woh =	2.13	ft	0.65	m
Beam Width, tw =	1.97	ft	23.6	in
Beam Depth, wd =	4.10	ft	49.2	in
Deck Depth, tt =	0.74	ft	8.9	in



Modeled as a T-Beam

wt =	6.23	ft	74.78	in	1.90	m
tw =	1.97	ft	23.62	in	0.60	m
l =	2.13	ft	25.58	in	0.65	m
d =	4.84	ft	58.07	in	1.47	m
tt =	0.74	ft	8.86	in	0.22	m
wd =	4.10	ft	49.21	in	1.25	m

Checked by: SAM

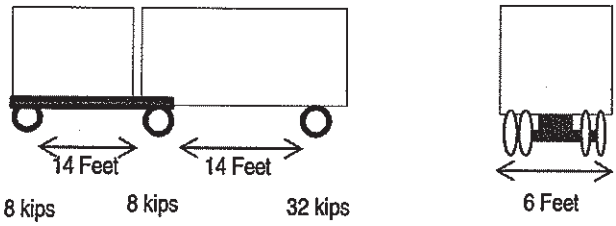
Live Loads

Wheel Distribution Width, E =	7.000	ft
Distribution Factor =	0.143	

E= 4 + 0.06 * S, Emax = 7' (Spans up to 50.0')

Truck Loading

Loading Designation = HS-25



Gross Weight of HS-20 =	72	kips	36	tons	
Design Gross Weight =	90	kips	45	tons	<--- Increased to Account for over-loaded trucks

	HS-20 W (kips)	HS-20 W (tons)	HS-20 Factor	Design W (tons)	Design W (kips)
Axle 1 =	8	4	1.25	5.00	10.00
Axle 2 =	32	16	1.25	20.00	40.00
Axle 3 =	32	16	1.25	20.00	40.00
Gross Vehicle Weight =	72	36	1.25	45	90

Military Live Load

1	lb	=	0.004	kN
1	k	=	4.448	kN
4.67	k	=	20.773	kN
9.34	k	=	41.546	kN

Wheel Spacing (out to out) =	131	in	10.92	ft	3.33	m
Wheel Width =	31	in	2.58	ft	0.79	m
Wheel Spacing (inside to inside) =	69	in	5.75	ft	1.75	m <-- Conspan Input
Wheel Spacing (cl to cl) =	100	ni	8.33	ft	2.54	m

MLC-70 (Axle Load)

UFC-3-310-08

Axle No.	Axle Weight (kips)	Spacing Number	Spacing Distance (ft)
1	21	1	12
2	42	2	5
3	42	3	15
4	28	4	4
5	28	5	0

Axle No	Axle Weight (kN)	Spacing Number	Spacing Distance (m)
1	93.41	1	3.66
2	186.83	2	1.52
3	186.83	3	4.57
4	124.55	4	1.22
5	124.55	5	0.00

Checked by: SAM

MLC-70 (Tracked Load)
UFC-3-310-08

Length of Track =	15	ft	4.572	m			
Total Load =	140	k	622.72	kN			
Load per Track =	70	Kips	311.36	kN			
Uniform Load per Track =	4.7	klf	68.1	kN/m	20.76	kN/ft	
Uniform Load per Axle =	9.3	klf	136.2	kN/m	41.51	kN/ft	

Axle No.	Track (kips)	Spacing Distance (m)	Track (kN)	Spacing Distance (m)
1	4.67	0	20.76	0.00
2	9.33	1	41.51	0.30
3	9.33	2	41.51	0.61
4	9.33	3	41.51	0.91
5	9.33	4	41.51	1.22
6	9.33	5	41.51	1.52
7	9.33	6	41.51	1.83
8	9.33	7	41.51	2.13
9	9.33	8	41.51	2.44
10	9.33	9	41.51	2.74
11	9.33	10	41.51	3.05
12	9.33	11	41.51	3.35
13	9.33	12	41.51	3.66
14	9.33	13	41.51	3.96
15	9.33	14	41.51	4.27
16	4.67	15	20.76	4.57
Total	140.00		622.72	

Checked by: SAM

Conspan

Live Load Distribution Factors

Exterior Beams	0.4423
	0.4423
Interior Beams	0.6979
	0.5187

Impact Factor, I = 0.2857 =50 / (L = 125) ft

Summary of Loads

	klf	Qty	klf	Rxn (kip)	Total (Kips)
Barrier =	0.660	2	1.32	20.55	41.11
Sidewalk =	0.505	1	0.50	7.86	15.72
Sloped Deck =	3.450	1	3.45	53.76	107.51
Constant Deck =	5.175	1	5.18	80.63	161.27
Rectangular Beams =	1.211	5	6.05	94.33	188.66
Stay in Place Forms =	0.043	5	0.21	3.32	6.64
Total DL =			16.72	260.46	520.91

Checked by: SAM

Moment & Shear (MLC-70)

* See hand calculations for backup

Distribution Width, E =	7.00	ft	= 4 + 0.06 * S (per AASHTO 3.24.3.2)
	2.13	m	

	Max Moment & Shears (Wheel Load)					
	MLC-70 Axle					
	Abutment			Pier		
V_LLmax =	110.7	k	492.4 kN	130.1	k	578.7 kN
V_LLmax / E =	16.0	klf	230.8 kN/lm	18.8	klf	271.3 kN/lm
M_LLmax =	1213.0	k-ft	1644.6 kN-m	1213.0	k-ft	1644.6 kN-m
M_LLmax / E =	174.8	k-ft/lf	770.9 kN-m/lm	174.8	k-ft/lf	770.9 kN-m/lm

	Max Moment & Shears (Wheel Load)					
	MLC-70 Axle Vechicle					
	Abutment			Pier		
V_LLmax =	55.4	k	246.2 kN	65.1	k	289.6 kN
V_LLmax / E =	8.0	klf	115.4 kN/lm	9.4	klf	135.7 kN/lm
1.6 * V_LLmax / E =	12.8	klf	184.7 kN/lm	15.0	klf	217.2 kN/lm
M_LLmax =	606.5	k-ft	822.3 kN-m	606.5	k-ft	822.3 kN-m
M_LLmax / E =	87.4	k-ft/lf	385.4 kN-m/lm	87.4	k-ft/lf	385.4 kN-m/lm
1.6 * M_LLmax / E =	139.8	k-ft/lf	616.7 kN-m/lm	139.8	k-ft/lf	616.7 kN-m/lm
1.6 * M_LLmax / E =	1678.0	k-in/lf		1678.0	k-in/lf	
	MLC-70 Tracked Vechicle					
	Abutment			Pier		
V_LLmax =	59.4	k	264.2 kN	64.8	k	288.2 kN
V_LLmax / E =	8.6	klf	123.9 kN/lm	9.3	klf	135.1 kN/lm
1.6 * V_LLmax / E =	13.7	klf	198.2 kN/lm	14.9	klf	216.2 kN/lm
M_LLmax =	726.8	k-ft	985.4 kN-m	726.8	k-ft	985.4 kN-m
M_LLmax / E =	104.7	k-ft/lf	461.9 kN-m/lm	104.7	k-ft/lf	461.9 kN-m/lm
1.6 * M_LLmax / E =	167.6	k-ft/lf	739.0 kN-m/lm	167.6	k-ft/lf	739.0 kN-m/lm
1.6 * M_LLmax / E =	2010.7	k-in/lf		2010.7	k-in/lf	

checked by: SAM

BRIDGE DECK

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BRIDGE DECK
REINFORCEMENT DESIGN

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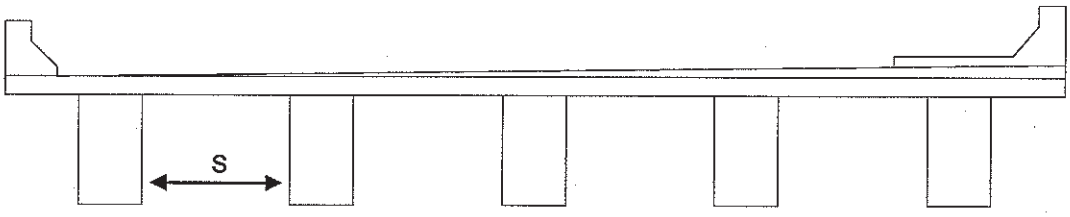
Bridge Deck Reinforcement Design

Project : Khost Bridge - Final Design
Description :

Designer : alh
Checker : SAM

Date : 9/21/2011
Date : 9/26/11

Notes/ Resources : ASSHTO 2002



Geometry

Bridge

Width = 31.5 ft
Length = 49.2 ft

Deck

Depth = 0.74 ft 8.88 in

Distribution of Loads

AASHTO 3.24

Effective Span Length, S = 4.26 ft AASHTO 3.24.1.2(a)

Case A - Main Reinforcement Perpendicular to Traffic

Spans 2-24'

$$M\_LL\ (no\ impact) = \frac{(S+2)}{32} * P\_truck$$

AASHTO 3.24.3.1

Truck = MLC-70
Max Axle Load = 42000 lbs
P_truck = 21000 lbs

M_LL (no impact) = 4108.13 lb-ft / 1' Width of Slab

Impact Factor, I = 0.287 I = 50 / (L + 125) < 30% AASHTO 3.8.2
Live Load Factor = 1.670

M_LL =	4108.1	lb-ft / LF	49.30	k - in / LF
M_LL + I =	5287.3	lb-ft / LF	63.45	k - in / LF
Mu_LL =	8829.7	lb-ft / LF	105.96	k - in / LF

See Attached Slab Flexure Design

Provide -->

	Bar Size	Spacing in	As_prov in^2 /ft
Top	#5	10	0.368
Bottom	#5	10	0.368

Distribution Reinforcement

Percentage of Main Reinforcement Required

% for Middle Half of Effective Span, S

Calculated % = 106.6% = 220 / sqrt (S)
Max Allowable % = 67.0%

Use ----> % = 67.0%

As_prov (main) = 0.368 in^2 /ft
As_req_D1 = 0.247 in^2 /ft s_req_D1 = 0.525 in^2

Try --> Bar Size = #5
Bar Area = 0.310 in^2
Spacing = 12.00 in
As_prov = 0.310 in^2 OK

Provide -->

	Bar Size	Spacing in	As_prov in^2 /ft
Top	#5	12.00	0.310
Bottom	#5	12.00	0.310

% for Outer Quarters of Effective Span, S

Min Allowable % = 50% of As_req_D1
As_req_D2 = 0.123

Try --> Bar Size = #5
Bar Area = 0.310 in^2
Spacing = 12.00 in
As_prov = 0.310 in^2 OK

Summary of Deck Reinforcement

Reinforcement & Location			Bar Size Eng	Spacing in	As_prov in^2 /ft	Bar Size Metric	Spacing mm
Main	All	Top	#5	10	0.368	#16	250
		Bot	#5	10	0.368	#16	250
Distribution	Middle Half of Span	Top	#5	12	0.310	#16	300
		Bot	#5	12	0.310	#16	300
	Outer Quarters	Top	#5	12	0.310	#16	300
		Bot	#5	12	0.310	#16	300

BRIDGE DECK TO BEAM REINFORCEMENT DESIGN

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Bentley			Sheet #	DS-1
			Job #	
Program:	LEAP® CONSPAN® V8i (SELECTseries 2)	EAS-RAI-USA	Designed By	
Version:	10.00.01.20	Copyright © Bentley Systems, Inc. 1984 - 2011	Date	Sept/12/2011
		www.bentley.com Phone: 1-800-778-4277	Checked	
File Name:	Khost_SS_600x1250.csl		Date	

SHEAR/MOMENT ENVELOPE (&REACTIONS)

SHEAR AND MOMENT ENVELOPE : Span : 1, Beam : 2, SERVICE 1
Shears: kips, Moments: kft

		Bearing	Trans	H/2	0.10L	0.20L	0.30L	0.40L	Midspan
Location,	ft	0.00	2.08	2.42	4.92	9.84	14.76	19.69	24.61
Self wt. :	M	0.0	59.5	68.6	132.0	234.6	308.0	352.0	366.6
	V	29.8	27.3	26.9	23.8	17.9	11.9	6.0	0.0
Prec. :	M	0.0	29.4	33.9	65.2	115.9	152.1	173.9	181.1
DL+ADL	V	14.7	13.5	13.3	11.8	8.8	5.9	2.9	0.0
Deck :	M	0.0	33.9	39.1	75.2	133.7	175.5	200.6	209.0
+ Haunch	V	17.0	15.5	15.3	13.6	10.2	6.8	3.4	0.0
Diaphragm :	M	0.0	0.0	0.0	0.1	0.2	0.2	0.3	0.4
	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Comp. :	M	0.0	15.9	18.3	35.2	62.6	82.2	93.9	97.8
DL+ADL	V	8.0	7.3	7.2	6.4	4.8	3.2	1.6	0.0
LL + I :	M+	0.0	211.9	244.4	471.0	839.1	1100.3	1258.7	1310.1
	V	106.6	100.8	99.9	93.0	68.8	50.2	25.8	1.3
LL + I :	M-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LL + I :	Vmx	106.6	101.5	100.7	94.6	82.2	69.5	56.8	44.1
	M	0.0	210.9	242.9	462.6	801.4	1016.5	1107.8	1075.4
Pedestrian:	M+	0.0	3.3	3.8	7.3	13.0	17.0	19.4	20.3
	V	1.6	1.5	1.5	1.3	1.0	0.7	0.3	0.0
Pedestrian:	M-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pedestrian:	Vmx	1.6	1.5	1.5	1.3	1.1	0.8	0.6	0.4
	M	0.0	3.1	3.6	6.6	10.4	11.9	11.7	10.1
Total :	M+	0.0	353.8	408.0	786.0	1399.2	1835.4	2098.8	2185.3
	V	177.7	165.9	164.0	149.9	111.5	78.7	40.0	1.3
Total :	M-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total :	Vmx	177.7	166.6	164.9	151.5	125.0	98.2	71.3	44.6
	M	0.0	352.7	406.3	776.9	1358.9	1746.5	1940.2	1940.5

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		0.60L	0.70L	0.80L	0.90L	H/2	Trans	Bearing
Location,	ft	29.53	34.45	39.37	44.29	46.79	47.13	49.21
Self wt. :	M	352.0	308.0	234.6	132.0	68.6	59.5	0.0
	V	6.0	11.9	17.9	23.8	26.9	27.3	29.8
Prec. :	M	173.9	152.1	115.9	65.2	33.9	29.4	0.0
DL+ADL	V	2.9	5.9	8.8	11.8	13.3	13.5	14.7
Deck :	M	200.6	175.5	133.7	75.2	39.1	33.9	0.0
+ Haunch	V	3.4	6.8	10.2	13.6	15.3	15.5	17.0
Diaphragm :	M	0.3	0.2	0.2	0.1	0.0	0.0	0.0
	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Comp. :	M	93.9	82.2	62.6	35.2	18.3	15.9	0.0
DL+ADL	V	1.6	3.2	4.8	6.4	7.2	7.3	8.0
LL + I :	M+	1258.7	1100.3	839.1	471.0	244.4	211.9	0.0
	V	25.8	50.2	68.8	93.0	99.9	100.8	106.6

Controlling Shear Results From CONSPAN Output					
		Applied Shear (kips)			
Load	Load Type	At Bearing	At Mid-Span	At dist. "d = 3.61 ft" Away From Support	At 10' From Support
Self Weight	Dead Loads	29.8	0.0	25.5	17.9
Prec.: DL + ADL	Dead Loads	14.7	0.0	12.6	8.8
Deck + Haunch	Dead Loads	17.0	0.0	14.5	10.2
Diaphragm	Dead Loads	0.0	0.0	0.0	0.0
Sidewalk & Barriers	Dead Loads	8.0	0.0	6.8	4.8
Total Dead Loads:		**69.5**	**0.0**	**59.5**	**41.7**
Vehicle Load	Live Loads	106.6	44.1	97.6	82.2
Pedestrian Load	Live Loads	1.6	0.4	1.4	1.1
Total Live Loads:		**108.2**	**44.5**	**99.0**	**83.3**

Horizontal Shear Design At Bearing

V_u = 1.3 x 69.5 + 1.67 x 108.2 = 271.0 Kips

Applied Sear Stress at interface v_u = V_u / b d

===> v_u = 271.0 / (23.6 * 43.3) = 0.265 ksi

= 265 psi

b = 23.6 in
d = 43.3 in
f_y = 60,000 psi
f'_c = 4,000 psi
ϕ= 0.90

Try S = 8 in Horiz. Shear Reinf. Spacing

Minimum Required Area of Steel $A_{s\text{-}min}$= 50 (b)(S)/f_y

$A_{s\text{-}min}$= 50.0 * 23.6 * 8.0 / 60,000

$A_{s\text{-}min}$= 0.157 in^2

Try #4 Bars ===> A_{vf} = 0.392 in^2 > As-min OK

Considering an Area "A_{cv}" of Shear Surface Having Length Equal To The Spacing of The Reinf. ===> A_{cv} = b * S

A_{cv} = 23.6 in * 8.0 in = 189 in^2

Shear Force Over A_{cv} = $V_{u\text{-}Acv}$ = v_u * A_{cv}

= 265 psi * 189.0 = 50077 lbs = 50.08 kips

Nominal Shear Resistance V_n = c A_{cv} + μ A_{vf} f_y

Where : c is Cohesion Factor (from reference 5.8.4.3) and μ is Friction Factor (from reference 5.8.4.3)

c = 0.28 ksi
μ = 1.0

V_n = 76.4 kips

Nominal Shear Resistance V_n shall not be greater than the lesser of :

K_1 f'_c A_{cv} Or K_2 A_{cv} Where: K_1 & K2 from reference 5.8.4.3

From reference 5.8.4.3 ===> K_1 = 0.3 , K_1 f'_c A_{cv}= 227 > Vn OK

K_2 = 1.8 , K_2 A_{cv}= 340 > Vn OK

Use V_n= 76.4 kips ===> ===> ϕ V_n= 68.8 > Vu-acv OK

Use #4 Bars @ 8 inch Spacing

Checked: EWR

Shear Design At Distance 3.61 ft Away From Support

V_u = 1.3 x 59.5 + 1.67 x 99.0 = 242.6 Kips

Applied Sear Stress at interface v_u = V_u / b d

===> v_u = 242.6 / (23.6 * 43.3) = 0.237 ksi

= 237 psi

b = 23.6 in
d = 43.3 in
f_y = 60,000 psi
f'_c = 4,000 psi
ϕ= 0.90

Try S = 12 in Horiz. Shear Reinf. Spacing

Minimum Required Area of Steel $A_{s\text{-}min}$= 50 (b)(S)/f_y

$A_{s\text{-}min}$= 50.0 * 23.6 * 12.0 / 60,000

$A_{s\text{-}min}$= 0.236 in^2

Try #4 Bars ===> A_{vf} = 0.392 in^2 > As-min OK

Considering an Area "A_{cv}" of Shear Surface Having Length Equal To The Spacing of The Reinf. ===> A_{cv} = b * S

A_{cv} = 23.6 in * 12.0 in = 283 in^2

Shear Force Over A_{cv} = $V_{u\text{-}Acv}$ = v_u * A_{cv}

= 237 psi * 283.5 = 67243 lbs = 67.24 kips

Nominal Shear Resistance V_n = c A_{cv} + μ A_{vf} f_y

Where : c is Cohesion Factor (from reference 5.8.4.3) and μ is Friction Factor (from reference 5.8.4.3)

c = 0.28 ksi
μ = 1.0

V_n = 102.9 kips

Nominal Shear Resistance V_n shall not be greater than the lesser of :

K_1 f'_c A_{cv} Or K_2 A_{cv} Where: K_1 & K2 from reference 5.8.4.3

From reference 5.8.4.3 ===> K_1 = 0.3 , K_1 f'_c A_{cv}= 340 > Vn OK

K_2 = 1.8 , K_2 A_{cv} = 510 > Vn OK

Use V_n= 102.9 kips ===> ===> ϕ V_n= 92.6 > Vu-acv OK

Use #4 Bars @ 12 inch Spacing

Checked EDW 96

Shear Design At Distance 10 ft Away From Support

V_u = 1.3 x 41.7 + 1.67 x 83.3 = 193.4 Kips

Applied Sear Stress at interface v_u = V_u / b d

===> v_u = 193.4 / (23.6 * 43.3) = 0.189 ksi

= 189 psi

b = 23.6 in
d = 43.3 in
f_y = 60,000 psi
f'_c = 4,000 psi
ϕ= 0.90

Try S = 18 in Horiz. Shear Reinf. Spacing

Minimum Required Area of Steel $A_{s\text{-}min}$= 50 (b)(S)/f_y

$A_{s\text{-}min}$= 50.0 * 23.6 * 18.0 / 60,000

$A_{s\text{-}min}$= 0.354 in^2

Try #4 Bars ===> A_{vf} = 0.392 in^2 > As-min OK

Considering an Area "A_{cv}" of Shear Surface Having Length Equal To The Spacing of The Reinf. ===> A_{cv} = b * S

A_{cv} = 23.6 in * 18.0 in = 425 in^2

Shear Force Over A_{cv} = $V_{u\text{-}Acv}$ = v_u * A_{cv}

= 189 psi * 425.2 = 80378 lbs = 80.38 kips

Nominal Shear Resistance V_n = c A_{cv} + μ A_{vf} f_y

Where : c is Cohesion Factor (from reference 5.8.4.3) and μ is Friction Factor (from reference 5.8.4.3)

c = 0.28 ksi
μ = 1.0

V_n = 142.6 kips

Nominal Shear Resistance V_n shall not be greater than the lesser of :

K_1 f'_c A_{cv} Or K_2 A_{cv} Where: K_1 & K2 from reference 5.8.4.3

From reference 5.8.4.3 ===> K_1 = 0.3 , K_1 f'_c A_{cv}= 510 > Vn OK

K_2 = 1.8 , K_2 A_{cv} = 765 > Vn OK

Use V_n= 142.6 kips ===> ===> ϕ V_n= 128.3 > Vu-acv OK

Use #4 Bars @ 18 inch Spacing

Checked

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BRIDGE JOINT DESIGN

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BRIDGE JOINTS

NOTE

* ASSUME BRIDGE WILL BE BUILT IN DRY SEASON → NOV TO FEB

AVERAGE TEMP BETWEEN NOV & FEB = 6°C (43°F)

HIGH TEMP = 35.4°C → ΔT = 29.4°C (85°F)
LOW TEMP = -0.9°C → ΔT = 6.9°C (45°F)
} SEE CLIMATE CHARTS FOR KHOST, AFGHANISTAN

MAXIMUM ONE-WAY THERMAL MOVEMENT

$$\delta_T = L \alpha \Delta T$$

L = 15m = 590.6 IN (1 SPAN)

$\alpha = 5.5 \times 10^{-6}$

$\Delta T = 85°F$

$$\therefore \delta_T = (590.6)(5.5 \times 10^{-6})(85) = 0.28''$$

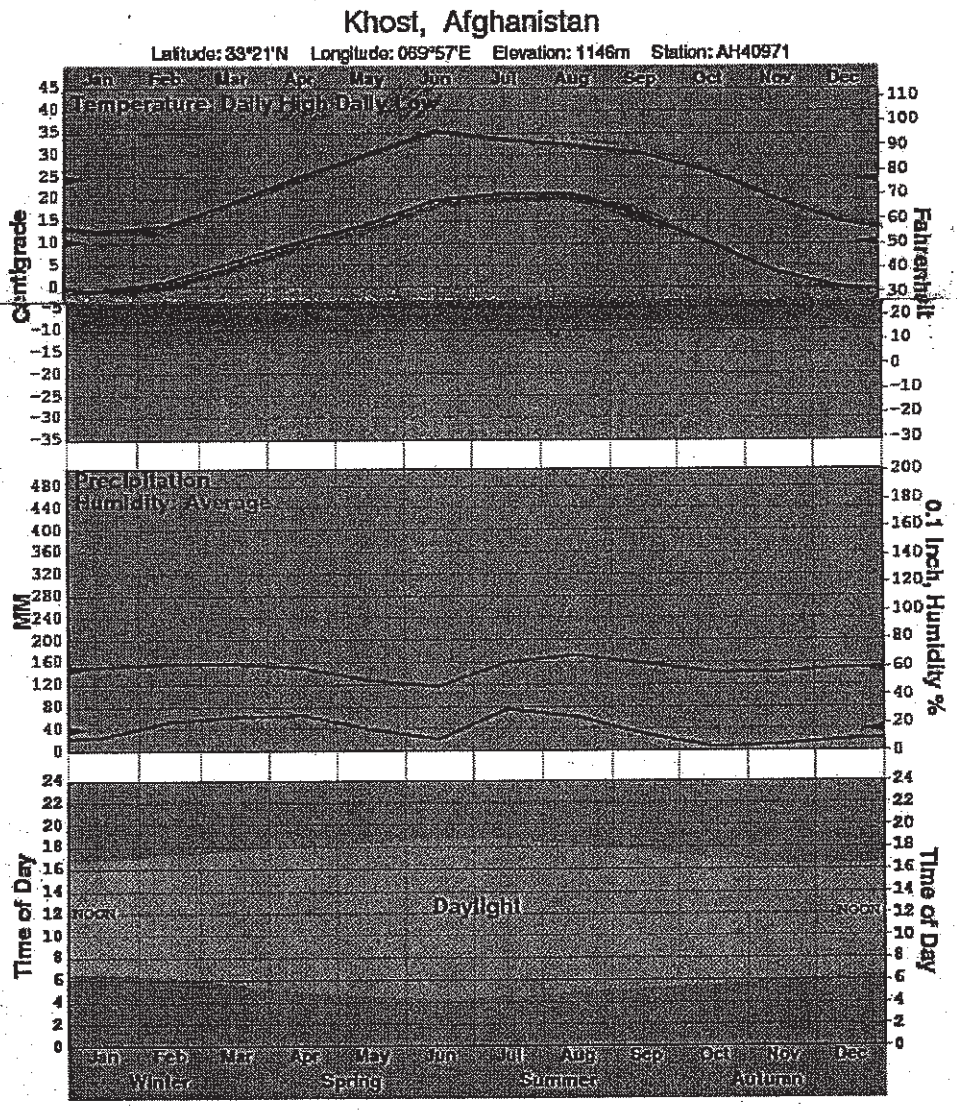
USE MASSDOT ASPHATIC JOINT DETAILS

TETRA TECH
One Grant Street
Framingham, MA 01701-9005
(508) 903-2000

JOB KHOST BRIDGE
SHEET NO. BRIDGE JOINTS OF
CALCULATED BY nav DATE 9/6/11
CHECKED BY AR DATE 9/11
SCALE

REFERENCE ONLY

Khost, Afghanistan: Climate, Global Warming, and Daylight Charts and Data



Data for Khost, Afghanistan

NOAA Station Id:	AH40971
Latitude:	33°21'N
Longitude:	069°57'E
Elevation:	1146m, 3760'

Sunrise and Sunset Data

The yellow section shows when the sun is up, and how this changes over the year. Use the time-of-day scales, on the left and right, and the month scale on the top and bottom, to tell approximately when sunrise and sunset occur. See Reading the Charts for more info.

The sunrise and sunset times shown in the chart are approximate. They are accurate for the latitude, and show the precise amount of daylight, but the rise and set times may be offset (up or down in the chart) since I don't have an automated way of matching time zones to longitudes. The charts are made assuming that the location is in the middle of an evenly spaced time zone.

For precise times see US Naval Observatory. For Khost, Afghanistan, use latitude 33°21'N and longitude 069°57'E in the form. You'll need to know the time zone of the location.

Climate (Average Weather) Data

Data is presented in both metric and "English" units.

NOAA Code	Statistic	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
0101	Temperature Mean Value	F	40.6	44.6	54	63.5	72.7	82.4	81.3	79.5	73.9	64.2	51.8	43.5	62.7
0201	High Temperature Mean Value	F	54.9	56.8	66.4	77.2	86.5	95.7	92.5	90.1	86.9	79.5	68.2	58.6	76.1
0301	Low Temperature Mean Value	F	30.4	34	42.4	50.7	57.7	67.6	70.3	70.2	61.7	50.5	38.5	32	50.5
0615	Precipitation Mean Monthly Value	Inches	1.1	2.2	2.5	2.7	1.6	0.9	3.1	2.5	1.3	0.3	0.5	0.9	1.6
0101	Temperature Mean Value	C	4.8	7.0	12.2	17.5	22.6	28.0	27.4	26.4	23.3	17.9	11.0	6.4	17.04
0201	High Temperature Mean Value	C	12.7	13.8	19.1	25.1	30.3	35.4	33.6	32.3	30.5	26.4	20.1	14.8	24.51
0301	Low Temperature Mean Value	C	-0.9	1.1	5.8	10.4	14.3	19.8	21.3	21.2	16.5	10.3	3.6	-0.0	10.28
0615	Precipitation Mean Monthly Value	mm	25.9	53.6	61.8	65.2	39.8	21.6	75.9	62.0	30.5	7.7	11.6	20.9	39.71
1101	Relative Humidity Mean Value	%	60.0	62.0	62.0	59.0	50.0	46.0	63.0	68.0	62.0	56.0	56.0	59.0	58.58

High temperature rank: in Afghanistan, 14 locations are cooler, 6 are warmer. Globally, 1952 are cooler, 1028 are warmer.
Precipitation rank: in Afghanistan, 18 locations are dryer, 2 are wetter . Globally, 837 are dryer, 3375 are wetter.
More about ranking and extremes

Latest Myth Debunked: Get The Facts On The US Chamber Position on Climate Change Here. www.USChamber.com/Facts
Afghanistan Conflict Our Troops are There Right Now. Show Your Support for Our Troops! USO.org
Temperature and Humidity How to measure & record temperature and humidity using data loggers www.acrsystems.com
AdChoices

Explanation, background, and discussion. Free mini-poster

World Climate Home > World Index > Afghanistan > Khost

Return to top of page

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BRIDGE BEAMS

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BRIDGE BEAMS

FLEXURAL REINFORCEMENT

DESIGN

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Rectangular Bridge Beam - Reinforcement Design

Project : Khost Bridge Final Design
Description :

Designer : alh
Checker : SAM

Date : 9/21/2011
Date : 9/28/2011

Notes :

Conversions

1 kN-m =	0.73756	k-ft
1 kN =	0.22481	kips

General

f'c =	4	ksi	εu =	0.003
Fy =	60	ksi	εt =	0.005
fs =	40	ksi		
ϕ =	0.9	(for Flexure)	ευ/(ευ+εt) =	0.375
β1 =	0.85	(for 4000psi)		

Geometry

Rectangular Beam

B =	1.97	ft	23.62	in	0.60	m
Bw =	1.97	ft	23.64	in	0.60	m
H =	4.10	ft	49.20	in	1.25	m
Hslab =	0.00	ft	0.00	in	0.00	m
Hbeam =	4.10	ft	49.20	in	1.25	m

dt =	45.81	in	cc_bot =	3	in
d =	43.44	in			

Determine Required Flexural Strength

Loads (See conspan - Span 1; Beam 2)

	M_{DL}	M_{LL}	
Service Load 1 :	1112.73	1732.87	kN-m
Factor :	1.3	1.67	AASHTO Table 3.22.1A
Mu :	1446.55	2893.89	kN-m

Mu_DL =	1446.5	kN-m	1066.9	k-ft	12803.0	k-in
Mu_LL =	2893.9	kN-m	2134.4	k-ft	25613.1	k-in
Mu =	4340.4	kN-m	3201.3	k-ft	38416.1	k-in

Checked by: SAM

Moment Strength to be Resisted by Concrete

Mu =	38416.1	k-in	
Mn =	42684.5	k-in	
Rn_max =	911	psi	<-- See table 6-1
ρt =	0.01806		<-- See table 6-2
d =	43.435	in	
dt =	45.805	in	= cc - bar area / 2
Rn =	860.592	psi	Rn < Rn_max, OK
ρ =	0.0190		ρ = ρt * (dt / d)
ω =	0.286		Enter Table 7-1 with ω = 0.286 and find Mn/f'cbd^2 = 0.2377
Mnt =	42404.9	k-in	<-- Resisted by the concrete

Required Moment Strength to be Resisted by Compression Reinforcement

Mn' =	279.6	k-in	23.30	k-ft	<-- Required Moment Strength to be resisted by the compression reinforcement

Determine the Compression steel stress, f's

Ca1 =	17.177	in
cc_top =	2	in
d' / Ca1 =	0.116	

Determine the total required reinforcement

As'_min = 0.11 in^2

Try -->

No of Rows =	2	
No of Bars / Row =	6	
Total No of Bars =	12	
Bar No. =	#8	
Bar Area =	0.79	in^2
Bar Diameter =	1.0	in

The LL will only act on the composite section therefore 1 Row of compression steel is adequate.

Total As_prov = 9.48 in^2 As' Prov > As' min, OK

Use As' = 9.48 in^2

As_min = 18.64 in^2 As = As'_min + ρ*b*d

Checked by: SAM

Check Moment Capacity

a = 13.47 in

ϕMn = 39360.85 kip-in OK

Compute As_req'd

As_req'd = 18.02 in^2 As = 0.85 * f'c * b * a / Fy

As_min = 18.64 in^2 As = As'_min + ρ*b*d

Try -->

No of Rows =	4	
No of Bars / Row =	7	
Total No of Bars =	28	
Bar No. =	#8	
Bar Area =	0.79	in^2
Bar Diameter =	1.0	in

Total As_prov = 22.12 in^2 As_Prov > As_Req'd & As_min, OK

As_Prov's - As_Req'd = 4.10 in^2

As_Prov's - As_min = 3.48 in^3

Check Minimum Reinforcement

for f'c < 4444 psi

ρmin = 0.0033 ρmin = 200 / Fy

As / Bw * d = 0.0204 <-- OK

Check Distribution of Reinforcement

Allowable Max Spacing

cc =	2.00	in
Smax1 =	10.00	in
Smax2 =	12.00	in
Smax =	10.00	in

Spacing Provided

S = 3.07 in S<=Smax, OK

Checked by: SAM

Stirrups are required throughout the distance where Compression reinforcement is required

Tie Bar No =	#4	
Bar Area =	0.20	in^2
Bar Diameter =	0.50	in

Max Spacing =	16.00	in
	24.00	in

Governing Max Spacing = 16.00 in

Stirrups	#4	Bars	@	16.00	in spacing

Table 7-1 Flexural Strength $M_n / \phi f'_c bd^2$ or $M_n / f'_c bd^2$ of Rectangular Sections with Tension Reinforcement Only

ω	.000	.001	.002	.003	.004	.005	.006	.007	.008	.009
0.00	0	.0010	.0020	.0030	.0040	.0050	.0060	.0070	.0080	.0090
0.01	.0099	.0109	.0119	.0129	.0139	.0149	.0159	.0168	.0178	.0188
0.02	.0197	.0207	.0217	.0226	.0236	.0246	.0256	.0265	.0275	.0285
0.03	.0295	.0304	.0314	.0324	.0333	.0343	.0352	.0362	.0372	.0381
0.04	.0391	.0400	.0410	.0420	.0429	.0438	.0448	.0457	.0467	.0476
0.05	.0485	.0495	.0504	.0513	.0523	.0532	.0541	.0551	.0560	.0569
0.06	.0579	.0588	.0597	.0607	.0616	.0626	.0634	.0643	.0653	.0662
0.07	.0671	.0680	.0689	.0699	.0708	.0717	.0726	.0735	.0744	.0753
0.08	.0762	.0771	.0780	.0789	.0798	.0807	.0816	.0825	.0834	.0843
0.09	.0852	.0861	.0870	.0879	.0888	.0897	.0906	.0915	.0923	.0932
0.10	.0941	.0950	.0959	.0967	.0976	.0985	.0994	.1002	.1001	.1020
0.11	.1029	.1037	.1046	.1055	.1063	.1072	.1081	.1089	.1098	.1106
0.12	.1115	.1124	.1133	.1141	.1149	.1158	.1166	.1175	.1183	.1192
0.13	.1200	.1209	.1217	.1225	.1234	.1243	.1251	.1259	.1268	.1276
0.14	.1284	.1293	.1301	.1309	.1318	.1326	.1334	.1342	.1351	.1359
0.15	.1367	.1375	.1384	.1392	.1400	.1408	.1416	.1425	.1433	.1441
0.16	.1449	.1457	.1465	.1473	.1481	.1489	.1497	.1506	.1514	.1522
0.17	.1529	.1537	.1545	.1553	.1561	.1569	.1577	.1585	.1593	.1601
0.18	.1609	.1617	.1624	.1632	.1640	.1648	.1656	.1664	.1671	.1679
0.19	.1687	.1695	.1703	.1710	.1718	.1726	.1733	.1741	.1749	.1756
0.20	.1764	.1772	.1779	.1787	.1794	.1802	.1810	.1817	.1825	.1832
0.21	.1840	.1847	.1855	.1862	.1870	.1877	.1885	.1892	.1900	.1907
0.22	.1914	.1922	.1929	.1937	.1944	.1951	.1959	.1966	.1973	.1981
0.23	.1988	.1995	.2002	.2010	.2017	.2024	.2031	.2039	.2046	.2053
0.24	.2060	.2067	.2075	.2082	.2089	.2096	.2103	.2110	.2117	.2124
0.25	.2131	.2138	.2145	.2152	.2159	.2166	.2173	.2180	.2187	.2194
0.26	.2201	.2208	.2215	.2222	.2229	.2236	.2243	.2249	.2256	.2263
0.27	.2270	.2277	.2284	.2290	.2297	.2304	.2311	.2317	.2324	.2331
0.28	.2337	.2344	.2351	.2357	.2364	.2371	.2377	.2384	.2391	.2397
0.29	.2404	.2410	.2417	.2423	.2430	.2437	.2443	.2450	.2456	.2463
0.30	.2469	.2475	.2482	.2488	.2495	.2501	.2508	.2514	.2520	.2527

$M_n / f'_c bd^2 = \omega(1-0.59\omega)$, where $\omega = \rho f_y / f'_c$

For design: Using factored moment M_u, enter table with $M_n/\phi f'_c bd^2$; find ω and compute steel percentage $\rho = \omega f'_c / f_y$

For investigation: Enter table with $\omega = \rho f_y / f'_c$; find value of $M_n/f'_c bd^2$ and solve for nominal strength, M_n.

Table 8-1 Design Parameters at Strain Limit of 0.005 for Tension-Controlled Sections

		$f'_c = 3000$, $\beta_1 = 0.85$	$f'_c = 4000$, $\beta_1 = 0.85$	$f'_c = 5000$, $\beta_1 = 0.80$	$f'_c = 6000$, $\beta_1 = 0.75$	$f'_c = 8000$, $\beta_1 = 0.65$	$f'_c = 10{,}000$, $\beta_1 = 0.65$
R_{nt}		683	911	1084	1233	1455	1819
ϕR_{nt}		615	820	975	1109	1310	1637
ω_t		0.2709	0.2709	0.2550	0.2391	0.2072	0.2072
ρ_t	Grade 40	0.02032	0.02709	0.03187	0.03586	0.04144	0.05180
	Grade 60	0.01355	0.01806	0.02125	0.02391	0.02762	0.03453
	Grade 75	0.01084	0.01445	0.01700	0.01912	0.02210	0.02762

BRIDGE BEAMS

SHEAR REINFORCEMENT

DESIGN

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EAS-RAI-USA

PROGRAM: LEAP® CONSPAN® V8i (SELECTseries 2)-v10.0.1
Bentley Systems, Inc. - www.bentley.com
PHONE : TOLL-FREE 1-800-778-4277

SHEET# 1
JOB NO.
BY DATE Sept/12/2011
CKD. DATE

PROJECT: Khost Bridge

Reference Only

SHEAR AND MOMENT ENVELOPE : Span : 1, Beam : 2, SERVICE 1

Shears: kips, Moments: kft

		Bearing	Trans	H/2	0.10L	0.20L	0.30L	0.40L	Midspan
Location,	ft	0.00	2.08	2.42	4.92	9.84	14.76	19.69	24.61
Self wt. :	M	0.0	59.5	68.6	132.0	234.6	308.0	352.0	366.6
	V	29.8	27.3	26.9	23.8	17.9	11.9	6.0	0.0
Prec. :	M	0.0	29.4	33.9	65.2	115.9	152.1	173.9	181.1
DL+ADL	V	14.7	13.5	13.3	11.8	8.8	5.9	2.9	0.0
Deck :	M	0.0	33.9	39.1	75.2	133.7	175.5	200.6	209.0
+ Haunch	V	17.0	15.5	15.3	13.6	10.2	6.8	3.4	0.0
Diaphragm :	M	0.0	0.0	0.0	0.1	0.2	0.2	0.3	0.4
	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Comp. :	M	0.0	15.9	18.3	35.2	62.6	82.2	93.9	97.8
DL+ADL	V	8.0	7.3	7.2	6.4	4.8	3.2	1.6	0.0
LL + I :	M+	0.0	211.9	244.4	471.0	839.1	1100.3	1258.7	1310.1
	V	106.6	100.8	99.9	93.0	68.8	50.2	25.8	1.3
LL + I :	M-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LL + I :	Vmx	106.6	101.5	100.7	94.6	82.2	69.5	56.8	44.1
	M	0.0	210.9	242.9	462.6	801.4	1016.5	1107.8	1075.4
Pedestrian:	M+	0.0	3.3	3.8	7.3	13.0	17.0	19.4	20.3
	V	1.6	1.5	1.5	1.3	1.0	0.7	0.3	0.0
Pedestrian:	M-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pedestrian:	Vmx	1.6	1.5	1.5	1.3	1.1	0.8	0.6	0.4
	M	0.0	3.1	3.6	6.6	10.4	11.9	11.7	10.1
Total :	M+	0.0	353.8	408.0	786.0	1399.2	1835.4	2098.8	2185.3
	V	177.7	165.9	164.0	149.9	111.5	78.7	40.0	1.3
Total :	M-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total :	Vmx	177.7	166.6	164.9	151.5	125.0	98.2	71.3	44.6
	M	0.0	352.7	406.3	776.9	1358.9	1746.5	1940.2	1940.5

		0.60L	0.70L	0.80L	0.90L	H/2	Trans	Bearing
Location,	ft	29.53	34.45	39.37	44.29	46.79	47.13	49.21
Self wt. :	M	352.0	308.0	234.6	132.0	68.6	59.5	0.0
	V	6.0	11.9	17.9	23.8	26.9	27.3	29.8
Prec. :	M	173.9	152.1	115.9	65.2	33.9	29.4	0.0
DL+ADL	V	2.9	5.9	8.8	11.8	13.3	13.5	14.7
Deck :	M	200.6	175.5	133.7	75.2	39.1	33.9	0.0
+ Haunch	V	3.4	6.8	10.2	13.6	15.3	15.5	17.0
Diaphragm :	M	0.3	0.2	0.2	0.1	0.0	0.0	0.0
	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Comp. :	M	93.9	82.2	62.6	35.2	18.3	15.9	0.0
DL+ADL	V	1.6	3.2	4.8	6.4	7.2	7.3	8.0
LL + I :	M+	1258.7	1100.3	839.1	471.0	244.4	211.9	0.0
	V	25.8	50.2	68.8	93.0	99.9	100.8	106.6
LL + I :	M-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LL + I :	Vmx	56.8	69.5	82.2	94.6	100.7	101.5	106.6
	M	1107.8	1016.5	801.4	462.6	242.9	210.9	0.0
Pedestrian:	M+	19.4	17.0	13.0	7.3	3.8	3.3	0.0
	V	0.3	0.7	1.0	1.3	1.5	1.5	1.6
Pedestrian:	M-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pedestrian:	Vmx	0.6	0.8	1.1	1.3	1.5	1.5	1.6
	M	11.7	11.9	10.4	6.6	3.6	3.1	0.0

PROJECT: Khost Bridge

Total	: M+	2098.8	1835.4	1399.2	786.0	408.0	353.8	0.0
	V	40.0	78.7	111.5	149.9	164.0	165.9	177.7
Total	: M-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	: Vmx	71.3	98.2	125.0	151.5	164.8	166.6	177.7
	M	1940.2	1746.5	1358.9	776.9	406.3	352.7	0.0

Reference only

PROJECT: Khost Bridge

REACTIONS (kips), SERVICE 1

Reference only

Load Type	Left Support	Right Support
Self Wt.	29.8	29.8
Deck+Haunch	17.0	17.0
Diaphragm	0.0	0.0
Prec. DL+ADL	14.7	14.7
Comp. DL+ADL	8.0	8.0
Live	106.6	106.6
Pedestrian	1.6	1.6

Upward reactions are positive.
Live Load reactions are per lane with no distribution factor and no impact.
Non-composite load types are per beam.
Composite and Pedestrian load types are per total bridge width.

Controlling Shear Results From CONSPAN Output

Load	Load Type	Applied Shear (kips)						
		At Bearing	At Mid-Span	At dist. "d = 3.61 ft" Away From Support	At 7' From Support	At 10' From Support	At 15' From Support	At 20' From Support
Self Weight	Dead Loads	29.8	0.0	25.5	21.5	17.9	11.9	6.0
Prec.: DL + ADL	Dead Loads	14.7	0.0	12.6	10.6	8.8	5.9	2.9
Deck + Haunch	Dead Loads	17.0	0.0	14.5	12.2	10.2	6.8	3.4
Diaphragm	Dead Loads	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sidewalk & Barriers	Dead Loads	8.0	0.0	6.8	5.8	4.8	3.2	1.6
		Total Dead Loads:		59.5	50.0	41.7	27.8	13.9
Vehicle Load	Live Loads	106.6	44.1	97.6	89.1	81.6	69.1	56.6
Pedestrian Load	Live Loads	1.6	0.4	1.4	1.3	1.1	0.9	0.6
		Total Live Loads:		99.0	90.4	82.7	70.0	57.2

SUMMARY : METRIC (ENG)

DISTANCE FROM SUPPORT	BAR SIZE	SPACING
1100 (3.61')	16Ø (#5)	200 (8")
2134 (7.0')	16Ø (#5)	250 (10")
3048 (10.0')	16Ø (#5)	300 (12")
4572 (15.0')	16Ø (#5)	450 (18")
6096 (20.0')	16Ø (#5)	450 (18")

SUM (METRIC)

START	END	BAR SIZE	# OF SPACES	SPACING	= LENGTH
0	3600	16Ø	18	200	3600
3600	4800	16Ø	4	300	1200
4800	7500	16Ø	6	450	2700

chkd: alh

Shear Design At Distance d = 3.61 ft Away From Support

V_u = 1.3 x 59.5 + 1.67 x 99.0 = 242.6 Kips

$V_c = 2*(f_c')^{0.5}*b*d$

f_c' = 4,000 psi

b = 23.6 in

d = 43.3 in

V_c = 129,409 psi = 129.4 ksi

ΦV_c = 0.75 * V_c = 97.1 ksi

Required ΦV_s = $V_u - \Phi V_c$ = 242.6 - 97.1 = 145.6 kips

====> $V_{s\text{-Rquired}}$ = 145.6 ÷ 0.75 = 194.1 kips

Try 8.0 in Ties Spacing ===> Av-min = 0.75 * $(f'c)^{0.5}$ * b * S / f_{yt} = 0.149 in^2

Try #5 Bars ===> A_v = 0.614 in^2 > Av-min OK

$V_s = A_v * f_{yt} * d / S$

f_{yt} = 60,000 psi

S = 8.0 in

V_s = 0.614 * 60,000 * 43.3 / 8.0

V_s = 199443 psi = 199.4 kips > Vs-Req. 194.1 OK

Chked:
aeh

Shear Design At Distance 7 ft Away From Support

V_u = 1.3 x 50.0 + 1.67 x 90.4 = 216.0 Kips

$V_c = 2*(f_c')^{0.5}*b*d$

f_c' = 4,000 psi

b = 23.6 in

d = 43.3 in

V_c = 129,409 psi = 129.4 ksi

ΦV_c = 0.75 * V_c = 97.1 ksi

Required ΦV_s = $V_u - \Phi V_c$ = 216.0 - 97.1 = 118.9 kips

====> $V_{s\text{-Rquired}}$ = 118.9 ÷ 0.75 = 158.5 kips

Try 10.0 in Ties Spacing ===> Av-min = 0.75 * $(f'c)^{0.5}$ * b * S / f_{yt} = 0.187 in^2

Try #5 Bars ===> A_v = 0.614 in^2 > Av-min OK

$V_s = A_v * f_{yt} * d / S$

f_{yt} = 60,000 psi

S = 10.0 in

V_s = 0.614 * 60,000 * 43.3 / 10.0

V_s = 159554 psi = 159.6 kips > Vs-Req. 158.5 OK

chkd:
aeh

Shear Design At Distance 10 ft Away From Support

V_u = 1.3 x 41.7 + 1.67 x 82.7 = 192.4 Kips

$V_c = 2*(f_c')^{0.5}*b*d$

f_c' = 4,000 psi

b = 23.6 in

d = 43.3 in

V_c = 129,409 psi = 129.4 ksi

ΦV_c = 0.75 * V_c = 97.1 ksi

Required ΦV_s = $V_u - \Phi V_c$ = 192.4 - 97.1 = 95.3 kips

====> $V_{s\text{-}Rquired}$ = 95.3 ÷ 0.75 = 127.1 kips

Try 12.0 in Ties Spacing ===> Av-min = $0.75 * (f'c)^{0.5} * b * S / f_{yt}$ = 0.224 in^2

Try #5 Bars ===> A_v = 0.614 in^2 > Av-min OK

$V_s = A_v * f_{yt} * d / S$

f_{yt} = 60,000 psi

S = 12.0 in

V_s = 0.614 * 60,000 * 43.3 / 12.0

V_s = 132962 psi = 133.0 kips > Vs-Req. 127.1 OK

Chkd:
alh

Shear Design At Distance 15 ft Away From Support

V_u = 1.3 x 27.8 + 1.67 x 70.0 = 153.0 Kips

$V_c = 2*(f_c')^{0.5}*b*d$

f_c' = 4,000 psi

b = 23.6 in

d = 43.3 in

V_c = 129,409 psi = 129.4 ksi

ΦV_c = 0.75 * V_c = 97.1 ksi

Required ΦV_s = $V_u - \Phi V_c$ = 153.0 - 97.1 = 55.9 kips

====> $V_{s\text{-Rquired}}$ = 55.9 ÷ 0.75 = 74.6 kips

Try 18.0 in Ties Spacing ===> Av-min = 0.75 * $(f'c)^{0.5}$ * b * S / f_{yt} = 0.336 in^2

Try #5 Bars ===> A_v = 0.614 in^2 > Av-min OK

$V_s = A_v * f_{yt} * d / S$

f_{yt} = 60,000 psi

S = 18.0 in

V_s = 0.614 * 60,000 * 43.3 / 18.0

V_s = 88641 psi = 88.6 kips > Vs-Req. 74.6 OK

chkd
aln

Shear Design At Distance 20 ft Away From Support

V_u = 1.3 x 13.9 + 1.67 x 57.2 = 113.7 Kips

$V_c = 2*(f_c')^{0.5}*b*d$

f_c' = 4,000 psi

b = 23.6 in

d = 43.3 in

V_c = 129,409 psi = 129.4 ksi

ΦV_c = 0.75 * V_c = 97.1 ksi

Required ΦV_s = $V_u - \Phi V_c$ = 113.7 - 97.1 = 16.6 kips

====> $V_{s\text{-Rquired}}$ = 16.6 ÷ 0.75 = 22.1 kips

Try 18.0 in Ties Spacing ===> Av-min = $0.75 * (f'c)^{0.5} * b * S / f_{yt}$ = 0.336 in^2

Try #5 Bars ===> A_v = 0.614 in^2 > Av-min OK

$V_s = A_v * f_{yt} * d / S$

f_{yt} = 60,000 psi

S = 18.0 in

V_s = 0.614 * 60,000 * 43.3 / 18.0

V_s = 88641 psi = 88.6 kips > Vs-Req. 22.1 OK

Chkd:
ah

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BEARINGS

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ELASTOMERIC BEARING DESIGN

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Elastomeric Bearing Design

General Information

Project Number: 1298-11006 USAID
Description: Khost Bridge
Structure:

Designed By: ALH
Checked By: APV
Date: 9/28/2011

References:
American Association of State Highway and Transportation Officals (AASHTO), Standard Specification for Highway Bridges
Service Load Design Method (Allowable Stress Design) of the AASHTO Specifications
Circular Steel Reinforced Elastomeric Bearing Pad Design - Method A
AASHTO 14.6.6 Elastomeric Pads and Steel Reinforced Elastomeric Bearings - Method A

Notes: Design is for a typical bearing to be used at all locations.

DETERMINE IF INTERNAL LOAD PLATE IS REQUIRED

If, under full dead load at the mean annual temperature for the bridge site, the inclination of the underside of the girder to the horizontal exceeds 0.01 rad, a tapered plate shall be used in order to provide a level load surface to be placed on the bearing. AASHTO 14.7.2

PGL =	0.00%		
Avg DL End Rotation =	0.0068	radians	<--- See "ROTATION" section for calculations.
Slope of BF due to DL Rotation =	0.68%		
BF Slope at Typical bearing =	0.68%		--> Internal Beveled Load Plate IS NOT Required

Min Beveled Load Plate Thickness =	0.118	in	3.0	mm	<--- 3/8" for beveled load plate, otherwise 11 gage
Bearing Diameter =	17.717	in	450.0		
Beveled Load Plate, Diameter =	17.467	in	443.6	mm	<--- Bearing Diameter - 1/8" cover
Slope, Beveled Load Plate =	0.0000	radians			<--- See "ROTATION" section for calculations if a beveled load plate is required.
Max Beveled Load Plate Thickness =	0.118	in	3.0	mm	
Avg Beveled Load Plate Thickness =	0.118	in	3.0	mm	

INPUT - Pad Geometry

All of the following dimensions are in inches unless noted otherwise. Use 11 gage steel reinforcement.

	Typical Bearing			
	in	mm		
Diameter D =	17.717	450.0		
Top Elastomer Layer $h_{max2=}$	0.118	3.0		
Top Plate Thickness (Average) =	0.118	3.0		
Inner Elastomer Layer $h_{max=}$	0.866	22.0	<-- Internal layers shall be of the same thickness	AASHTO 14.6.6.1
Inner Steel Reinforcement Thickness =	0.118	3.0	<-- 11 gage	
Number of Inner Layers =	4.000	4.0		
Bottom Elastomer Layer $h_{max1=}$	0.157	4.0		
hrt = Design Total Elastomer Thickness =	3.740	95.000		
Actual Total Bearing Thickness =	4.331	110.000		
Is Top Elast Layer < 70% of Inner Layer ?	OK	OK		AASHTO 14.6.6.1
Is Bot Elast Layer < 70% of Inner Layer ?	OK	OK		

Compute Shape Factors

S inner= D/(4*h) =	5.11	AASHTO 14.3
S top= D/(4*h) =	37.50	
S bottom= D/(4*h) =	28.13	

Elastomeric Bearing Design

General Information

Project Number:	1298-11006 USAID	**Designed By:**	ALH
Description:	Khost Bridge	**Checked By:**	Apr
Structure:		**Date:**	9/28/2011

INPUT - Material Properties

Grade:	60	durometer reinforced bearings		ASTM Requirements	AASHTO Fig: 14.6.5.3.3-1
Gmin = Shear Modulus =	130.00	psi	OK	Neoprene = D4014	AASHTO 14.6.5.2-1 &
Gmax = Shear Modulus =	200.00	psi	OK	Natural Rubber = D4014	AASHTO 14.6.6.2
F_y =	33.0	ksi			AASHTO 1997 C18.4.1.1.2
F_{sr} =	24.0	ksi	Fsr = Allowable fatigue stress range for over 2,000,000 cycles (ksi)		AASHTO Table 10.3.1A

INPUT - Service Loads

Dead Load

Self weight	132.55	kN
Deck + Haunch	75.62	kN
Diaphragm	0.00	kN
Prec DL+ADL	65.39	kN
Comp. DL+ADL	35.58	kN

Live Load

Vehicular (+ impact)	474.16	kN
Impact Factor	1.287	
Vehicular (no impact)	368.42	kN
Pedestrian	7.12	kN

Total Dead Load =	69.5	kips =	309.14	kN
LL (no impact) =	84.4	kips =	375.54	kN
DL+LL (no impact) =	153.9	kips =	684.68	kN

COMPRESSIVE STRESS (14.6.6.3.2) - Inner Layers

(ONE CIRCULAR BEARING PAD PER BEAM)

For Bearings subject to Shear Deformation

The value S used shall be for the thickest layer of the bearing.

Bearing Thickness (in)		
Abutment	Typical	
Top	0.118	
Inner	0.866	<-- Governing, Use the S Value associated with the thickest layer
Bottom	0.157	
Max	0.866	

No. of Bearing per Beam, N_bb = 1

Plan Area, A1 =	246.52	in^2	
S (Max Layer) =	5.11		
Allowable Overstress, OS =	1.00	<-- These stress limits may be increased to 10% where shear deformation is prevented.	AASHTO 14.6.6.3.2

Average Compressive Stress, σ_{TL} =	0.624	ksi = (DL+LL)/ A1/ N_bb	<=	1.00 ksi*OS =	1.000 ksi	OK
Average Compressive Stress, σ_{TL} =	0.624	ksi = (DL+LL)/ A1/ N_bb	<=	1.00GS*OS =	0.665 ksi	OK
σ_L =	0.342	ksi = (LL_no impact)/ A1/ N_bb				

Elastomeric Bearing Design

General Information

Project Number: 1298-11006 USAID
Description: Khost Bridge
Structure:

Designed By: ALH
Checked By:
Date: 9/28/2011

COMPRESSIVE DEFLECTION (14.6.6.3.3, 14.6.5.3.3)

s_{TL} = 0.624 ksi
s_{LL} = 0.342 ksi

Creep deflection at 25 years / Instaneous Deflection

$\delta_{creep25} / \delta_{TL}$ = 35 % — AASHTO Tab: 14.6.5.2-1

	Typical Bearing				
	Inner	Top	Bottom		
S =	5.11	37.50	28.13		
Comp strain (Total Load) %, ε_{TL} =	3.80	2.50	2.50		AASHTO Fig: 14.6.5.3.3-1
Comp strain (Live Load) %, ε_{LL} =	2.25	1.40	1.40		AASHTO Fig: 14.6.5.3.3-1
Instantaneous Deflection δ_{TL} =	0.139			= Σ (ε_{TL} * hrt)	
Long Term Deflection TL =	0.187			= (1 + $\delta_{creep25} / \delta_{TL}$ / 100) * δ_{TL}	
Instantaneous Deflection LL =	0.082				
Relative deflection=	0.057				
Is Relative Deflection OK?	Relative Deflection < .125in - OK				AASHTO 14.6.5.3.3

SHEAR (14.6.6.3.4)

Span Length =	15.000	m =	49.213 ft	
Long. Dist. Subject to Temp. =	49.213	ft/brg	--> Assumes a fixed bearing and expansion bearing and that the thermal expansion length is the full span.	
Superstructure width =	31.170	ft		
Trans. Dist. Subject to Temp. =	15.585	ft/brg	--> Half width of superstructure	
a =	0.0000055	/deg F	--> Mild Steel = 0.00000645 ; Concrete = 0.0000055	AASHTO 14.4
D Temperature =	85	deg		
Long. Thermal Movement =	0.276	in	--> $Delta_{sL}$	
Transv. Thermal Movement =	0.087	in	--> $Delta_{sT}$	
Coeff of Shrinkage =	0.000200			AASHTO 8.5.4
Long. Shrinkage Movement =	0.118	in		
Transv. Shrinkage Movement =	0.037	in		
Total Longit. Movement =	0.394	in		
Total Trans Movement =	0.125	in		
Resultant Movement, Ds =	0.413	in		
2x(Movement)=	0.827	in		
hrt (typical brg) =	3.740	in	--> Elastomer Thickness - OK	

Elastomeric Bearing Design

General Information

Project Number: 1298-11006 USAID
Description: Khost Bridge
Structure:

Designed By: ALH
Checked By: APC
Date: 9/28/2011

ROTATION (14.4.1, 14.6.6.3.5)

Span Length, L = 49.21 ft = 590.55 inches
Impact = 1.29

AASHTO 3.8.2.1

	Beam 1	Beam 2	Beam 3	Beam 4	Beam 5	Average
Total midspan Deflection (mm) =	31.379	31.379	31.379	31.379	31.379	
LL+I midspan Deflection (mm) =	5.719	5.719	5.719	5.719	5.719	
LL (no impact) midspan Deflection (mm) =	4.444	4.444	4.444	4.444	4.444	
LL (ped) midspan Deflection (mm) =	0.020	0.020	0.020	0.020	0.020	
DL midspan Deflection (in) =	1.010	1.010	1.010	1.010	1.010	
LL (no impact) midspan Deflection (in) =	0.176	0.176	0.176	0.176	0.176	
PGL Rotation, radians =						0.0000
DL Rotation (4*D/L), radians =	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068
LL end Rotation (4*D/L), radians =	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012
Uncertainty Allow. Rotation =						0.005

Design Rotation, θm (AASHTO 14.4.1)

	Typical Bearing
PGL Rotation, radians =	0.0000
Avg DL end Rotation, radians =	0.0068
Avg LL end Rotation, radians =	0.0012
Uncertainty Allow. Rotation =	0.0050
TOTAL DESIGN ROTATION, Om =	**0.0130**
n =	4.000
S (thickest layer) =	5.114
x1 = 0.375*Gmax*S =	0.384
x2 = $(D/hri)^2$ =	418.388
x3 = Om/n =	0.003
smin = x1*x2*x3 =	0.523
s_{TL} =	0.624
s_{TL} > smin ?	Max Rotation OK

* The design rotation shall be taken as the sum of the dead and live load rotations.
An allowance for uncertainties is normally taken as less than 0.005 rad.

Elastomeric Bearing Design

General Information

Project Number:	1298-11006 USAID	**Designed By:**	ALH
Description:	Khost Bridge	**Checked By:**	APL
Structure:		**Date:**	9/28/2011

STABILITY (14.6.6.3.6)

Total Thickness, Typical Bearing =	4.331	in	--> Stability OK
D/4 =	4.429	in	

REINFORCEMENT (14.6.6.3.7, 14.6.5.3.7)

h_{rmax} =	0.86614	in		
s_{TL} =	0.624	ksi		
s_{LL} =	0.342	ksi		
h_s =	0.1181	in	--> Using 11 gage	
h_{S1} =	0.049	in	< hs, OK	AASHTO Eq. 14.6.5.3.7-1
h_{S2} =	0.025	in	< hs, OK	AASHTO Eq. 14.6.5.3.7-2

LOADS FOR SUBSTRUCTURE DESIGN (14.5.3.1, 14.5.3.2)

MAX TEMPERATURE RISE/FALL

Gmax =	200.0	psi	
A =	246.5	in^2	
hrt (min)=	3.740	in	
Long. Dist. Subject to Temp. =	49.213	ft/brg	--> Expansion bearing at each Abutment
D Temperature =	85	deg	--> Max Temp Rise/Fall - See Bridge Joints Calculations
Long. Thermal Movement, Ds =	0.276	in	
Hm = GADs/hrt =	3.64	kips	
Number of Bearings / Abut =	5		
Total Thermal Force for Abut Design =	**18.20**	**kips**	**<--- Thermal load to be included in the Substructure Design**
Coefficient for Sliding =	0.2		
Cooresponding Compressive Load, Pm =	90.98	kips	**< OK, Actual Compressive Load is greater than required to counteract sliding**

MAX TEMPERATURE FALL

Gmax =	200.0	psi	
A =	246.5	in^2	
hrt (min)=	3.740	in	
Long. Dist. Subject to Temp. =	49.213	ft/brg	--> Expansion bearing at each Abutment
D Temperature =	45	deg	--> Max Temp Rise/Fall - See Bridge Joints Calculations
Long. Thermal Movement, Ds =	0.146	in	
Hm = GADs/hrt =	1.93	kips	
Number of Bearings / Abut =	5		
Total Thermal Force for Abut Design =	**9.63**	**kips**	**<--- Thermal load to be included in the Substructure Design**
Coefficient for Sliding =	0.2		
Cooresponding Compressive Load, Pm =	48.17	kips	**< OK, Actual Compressive Load is greater than required to counteract sliding**
Gmax =	0.20	ksi	
Sinner =	5.11		
Ec = 6*G*S^2 =	31.38	ksi	
I =	4835.95	in^4	
Om =	0.0130	rads	
hrt (min)=	3.740	in	
Max Bending Moment, Mm =	**264.39**	**kip*in**	**<----Maximum moment that can be transferred by the bearing to the substructure.**

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FIXED BEARING ANCHOR DESIGN

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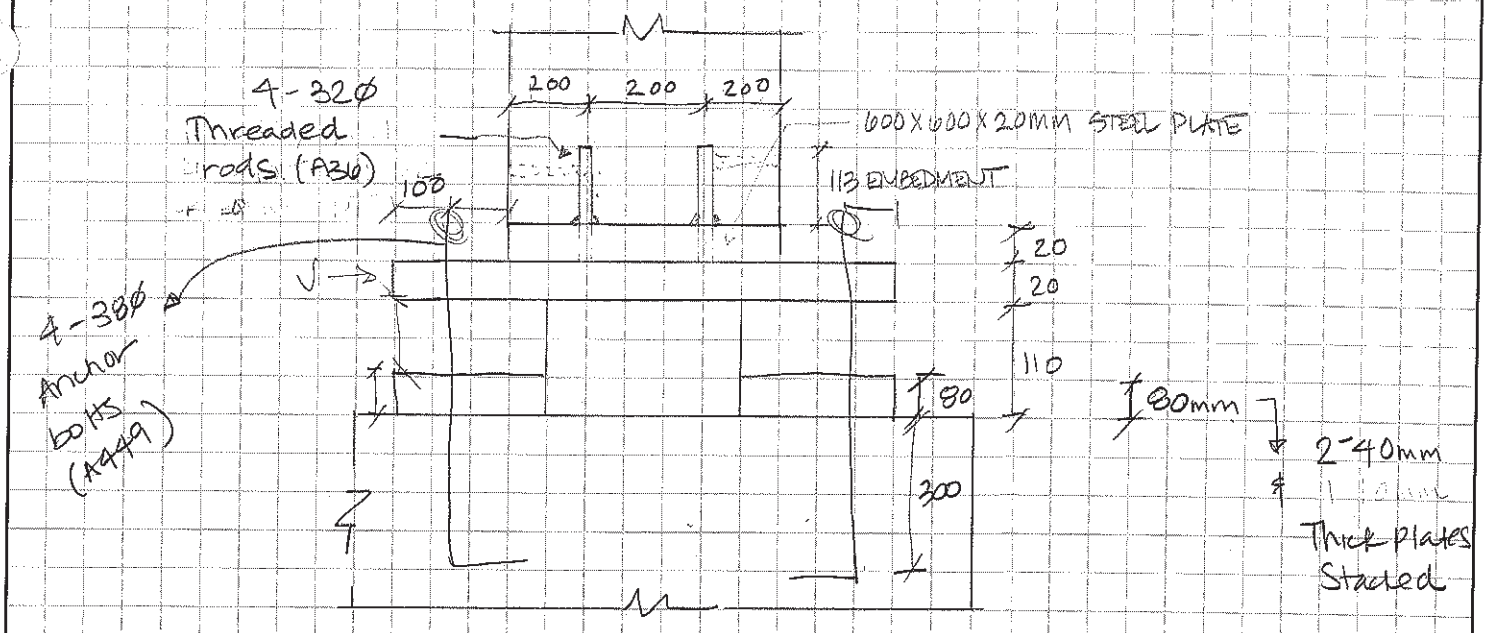
BEARING ANCHORAGE



V = 178K / 5 BEARINGS = 35.6 K / BEARING

TRY 1.25" A36 THREADED ROD

For f'c = 4000 PSI

SHEAR CAPACITY = 12.1 K

35.6 K / 12.1 K = 2.3 SAY 4 RODS

USE 4 - 1.25" THREADED A36 ROD

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JOB
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SCALE

Design Anchorage from Steel Plate abover bearing to Abutment Seat

BY:
CHK: APL 9/11

Geometric Section S

Circle - Axis of Moments through Center

S_bolt = pi * d^3 / 32 (per AISC Table 17-27)

Bolt Type = A449

Diameter in	S_bolt in^3
0.625	0.024
0.75	0.041
0.875	0.066
1.5	0.331

Bearing Height =	4.33	in	
Use Bolt Diameter =	1.5	in	
Sbolt =	0.331	in^3	
V =	35.6	kips/ bearing	<-- See Backwall / Cheekwall for backup calculations
Fu =	105	kips	
Fv =	17.85	kips/ bolt	
Fy =	81000	psi	
Compressive bending Stress, Fb =	44550	psi	<-- Fb = 0.55 * fy per ASSHTO chapter 10

Lug Thickness in	Arm in	M k-in	M lb-ft	Sxreq in^3	S in^3	Bolts Required	S in^3
0.5	3.83	136	11362	3.06	0.331	10	3.31
1	3.33	119	9879	2.66	0.331	9	2.98
1.5	2.83	101	8396	2.26	0.331	7	2.32
2	2.33	83	6912	1.86	0.331	6	1.99
2.5	1.83	65	5429	1.46	0.331	5	1.66
3	1.33	47	3946	1.06	0.331	4	1.33
3.5	0.83	30	2462	0.66	0.331	3	0.99
4	0.33	12	979	0.26	0.331	1	0.33
4.25	0.08	3	237	0.06	0.331	1	0.33

Try -->

No of Bolts =	4			
Lug Thickness =	3	in	75	mm

Check Fv

V =	35.6	kips	
Fv =	71.4	kips	OK

Use -->

No of Bolts =	4	
No of Plates =	2	
Plate Thickness =	40	mm
Total Lug Thickness =	80	mm

SUBSTRUCTURE

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ABUTMENT

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ABUTMENT LOADING CALCULATIONS

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ABUTMENT LOADING CALCULATIONS

GENERAL INFORMATION

Project Number:	127-1298-10001-LT0009	Designed By:	nav
Description:	USAID - Khost Bridge	Checked By:	JZ
Structure:	Abutment Loading (Longitudinal Direction)	Date:	9/27/2011

References: AASHTO Standard Specification for Highways and Bridges, 17th Edition, 2002

Notes: This spreadsheet computes the loads on a abutment, considering the spans left or right of the abutment is simply supported.

ABUTMENT GEOMETRY

Total Length of Bridge =	195	m	639.76	ft
Number of Spans =	13			
Span Length =	15.00	m	49.21	ft
Top of Roadway Elevation =	1188.890	m	3900.56	ft
Top of Bridge Seat/Abutment Elevation =	1187.231	m	3895.11	ft
Top of Footing Elevation =	1181.131	m	3875.10	ft
Bottom of Footing Elevation =	1180.131	m	3871.82	ft
Elevation of High Water =	1186.190	m	3891.70	ft
Assumed Bearing Height =	0.110	m	0.36	ft
Distance from T.O. Roadway to Bridge Seat =	1.659	m	5.44	ft
Number of Lanes =	2			

Abutment Bridge Seat Width =	1.00	m	3.28	ft
Abutment Length =	9.50	m	31.17	ft
Abutment Height =	8.759	m	28.74	ft
Stem Height =	6.10	m	20.01	ft
Backwall Height =	1.659	m	5.44	ft
Footing Height =	1.00	m	3.28	ft
Footing Width =	6.50	m	21.33	ft
Footing Length =	12.00	m	39.37	ft

ABUTMENT LOADING CALCULATIONS

GENERAL INFORMATION

Project Number:	127-1298-10001-LT0009	Designed By:	nav
Description:	USAID - Khost Bridge	Checked By:	JZ
Structure:	Abutment Loading (Longitudinal Direction)	Date:	9/27/2011

SUPERSTRUCTURE GEOMETRY

Deck:

Superstructure Width =	9.5	m	31.17	ft
Roadway Cross-Slope =	2	%		
Structural Slab Thickness =	225	mm	8.86	in
Max Structural Slab Thickness =	406	mm	15.98	in
Total Deck Area =	30.22	ft^2 / LF		

Sidewalk:

# of Sidewalks =	1			
Sidewalk Width =	1.2	m	3.94	ft
Average Sidewalk Thickness =	0.2	m	0.66	ft
Total Sidewalk Area =	2.58	ft^2 / LF		

Girders:

# of Girders =	5			
Girder Depth =	1.25	m	4.10	ft
Girder Width =	0.6	m	1.97	ft
Total Girder Area =	40.36	ft^2 / LF		

Barrier:

# of Barriers =	2			
Barrier Height =	1.05	m	3.44	ft
Barrier Width =	0.45	m	1.48	ft
Total Barrier Area =	10.17	ft^2 / LF		

ABUTMENT LOADING CALCULATIONS

GENERAL INFORMATION

Project Number:	127-1298-10001-LT0009	Designed By:	nav
Description:	USAID - Khost Bridge	Checked By:	JZ
Structure:	Abutment Loading (Longitudinal Direction)	Date:	9/27/2011

SUPERSTRUCTURE LOADING ON ABUTMENT - VERTICAL FORCES

Dead Load, DL

				Unit Weight			
Total Deck Area =	30.22	ft^2 / LF	x	150	pcf	4.53	kips / ft / LF
Total Girder Area =	40.36	ft^2 / LF	x	150	pcf	6.05	kips / ft / LF
Total Side Walk Area =	2.58	ft^2 / LF	x	150	pcf	0.39	kips / ft / LF
# of Barriers =	10.17	ft^2 / LF	x	150	pcf	1.53	kips / ft / LF

	Left/Right Span	
L =	49.21	ft
Total Superstructure Weight =	12.50	kips / ft / LF
Reaction, Dead Load =	307.59	kips
Conspan Total Dead Load =	347.5	kips <---DL from Conspan includes additional superstructure loads not included in section above

Total Reaction, Dead Load = 347.50 kips

Load Application = 1.7 *ft (Long)* <----- load from front face of abutment

Live Load, LL

Truck Loading:

	Left/Right Span		
L =	49.21	ft	
Impact (I) =	1.00	= 1 + 50/(L + 125) ≤ 1.3 <----- Impact not included in Abutment Design.	Section 3.8.2.1
Number of Lanes =	2		
Reduction in Load Intensity =	1		Section 3.12.1
AASHTO Vmax =	58.30	kips	App. A, "LOADING - HS 20-44 (MS18)
Vmax =	116.61	kips	
H25 Multiplier =	1.25		
Reaction, LL V =	145.8	kips	
Reaction, (LL+I) V =	145.8	kips	

Total Reaction, Truck (LL) = 146 kips *<== Greater Than Lane Load (LL), Controls*

Total Reaction, Truck (LL+I) = 146 kips *<== Greater Than Lane Load (LL), Controls*

ABUTMENT LOADING CALCULATIONS

GENERAL INFORMATION

Project Number:	127-1298-10001-LT0009	Designed By:	nav
Description:	USAID - Khost Bridge	Checked By:	JZ
Structure:	Abutment Loading (Longitudinal Direction)	Date:	9/27/2011

SUPERSTRUCTURE LOADING ON ABUTMENT - VERTICAL FORCES (CONT.)

Live Load, LL (cont.)

Lane Loading:

Number of Lanes = 2
Reduction in Load Intensity = 1
HS-20 Lane Load = 640 plf
HS-25 Lane Load = 1600 plf <------- Increase HS-20 by : 25%

Section 3.12.1
Figure 3.7.6B

Left/Right Span
Reaction, Lane Load (LL) = 39.4 kips
Reaction, Lane Load (LL+I) = 39.4 kips

Number of Lanes = 2
Reduction in Load Intensity = 1
HS-20 Concentrated (LL) = 26 kips <------- Concentrate load for shear
HS-25 Concentrated (LL) = 65 kips <------- Increase HS-20 by : 25%

Section 3.12.1
Figure 3.7.6B

HS-25 Concentrated (LL+I) = 65 kips (using Max Impact from Both Spans)

Total Reaction, Lane Load (LL) = 104 kips <== *Less Than Truck (LL), Does Not Control*

Total Reaction, Lane Load (LL+I) = 104 kips <== *Less Than Truck (LL+I), Does Not Control*

Controlling Live Load, LL & LL+I

Total (LL) = 146 *kips on Abutment* <-- Run 1: Bearing Pressure & Footing Design

Total (LL+I) = 146 *kips on Abutment* <-- Run 2: Abutment Stem Design

Load Application = 1.7 *ft (Long)* <----- load from front face of abutment

ABUTMENT LOADING CALCULATIONS

GENERAL INFORMATION

Project Number:	127-1298-10001-LT0009	Designed By:	nav
Description:	USAID - Khost Bridge	Checked By:	JZ
Structure:	Abutment Loading (Longitudinal Direction)	Date:	9/27/2011

SUPERSTRUCTURE LOADING ON ABUTMENT - LATERAL FORCES

Longitudinal Live Load Calculation, LF — Section 3.9

Number of Lanes = 2

Reduction in Load Intensity = 1 — Section 3.12.1

HS-20 Concentrated (LL) = 18 kips <-------- Concentrate load for moment — Figure 3.7.6B

HS-25 Concentrated (LL) = 45 kips <-------- Increase HS-20 by : 25%

LL on Abutment + Concentrated Load = 129 kips

Long. Load on Abutment (LF) = 6.45 kips <--- (5% * (Total Lane Load + Concentrated Load))

Load Application = 6.00 *ft Above Roadway Deck* = 11.44 ft above bearing seat

Wind Load on Live Load, WL

WL = 100 plf (Conservative to Apply in Longitudinal Direction Only) — Section 3.15.2.1

Left/Right Span

Reaction, WL per span = 2.46 kips

Total Reaction, Wind Load on LL (WL) = 2.46 kips

Load Application = 6.00 *ft Above Roadway Deck* = 11.44 ft above bearing seat

ABUTMENT LOADING CALCULATIONS

GENERAL INFORMATION

Project Number:	127-1298-10001-LT0009	Designed By:	nav
Description:	USAID - Khost Bridge	Checked By:	JZ
Structure:	Abutment Loading (Longitudinal Direction)	Date:	9/27/2011

SUMMARY OF SUPERSTRUCTURE LOADS ON ABUTMENT

LOAD		Longitudinal		Note: Load Application	
		Load (Kips)	Arm from Face of Abutment Stem (ft):		
Superstructure Dead Load	DL	347.50	1.72	Apply at midpoint of Bridge Seat	
Live Load (No Impact)	LL	145.80	1.72	Apply at midpoint of Bridge Seat	
Live Load (w/ Impact)	LL + I	145.80	1.72	Apply at midpoint of Bridge Seat	
Live Load (No Impact) - MLC 70	LL	236.75	1.72	Apply at midpoint of Bridge Seat	<---See MLC-70 Loading - ConSpan
Wind Load on Live Load	WL	2.46	11.44	Apply above Bridge Seat	
Longitudinal & Friction	LF	6.45	11.44	Apply above Bridge Seat	
Thermal Force	T	9.63	0.36	Apply above Bridge Seat	<---See Elastomeric Bearing Calcs
Seismic Force	EQ	177.23	3.50	Apply at the centriod of Superstructure	<---See Seismic Design Calcs

MLC 70 LOADING PER CONSPAN

SEE CONSPAN RESULTS FOR BEAMS 1,2 & 5

CONSPAN LL + I (VMAX) = 679.2 kN (152.69K) (BEAM 1,2, & 5)

$$I = \frac{50}{L + 125} = \frac{50}{(49.21 + 125)} + 1 = \underline{1.29}$$

LIVE LOAD W/O IMPACT = $\frac{152.69^K}{1.29}$ = 118.4^K PER LANE

∴ MLC LOADING FOR:

ABUTMENT = 118.4^K * 2 LANES = $\underline{236.8^K}$

PIER = 118.4^K * 2 LANES * 2 SPANS = $\underline{473.6^K}$

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JOB KHOST BRIDGE
SHEET NO. MLC LOADING OF
CALCULATED BY NAV DATE 9/16/11
CHECKED BY RT DATE 9/27/11
SCALE

SEISMIC LOADING FOR SUBSTRUCTURE

NOTE:

① THIS DESIGN ASSUMES FIX-EXP, SO THAT ONE PIER WOULD ONLY SEE SEISMIC LOAD FROM ONE SPAN.

② IF DOUBLE FIXED BRIDGE USED AT PIERS, PIER LOAD WOULD BE DOUBLE & ABUTMENT LOAD WOULD = 0.

max TRIB LENGTH = 49.21'

DEAD LOAD PER CONSPAN:

(29.8 + 14.7 + 17 + 8) = 69.5 (PER 1 BEARING)
* 5 (BEAMS)
* 2 (FULL LOAD TO ONE BEARING)
695^k

PGA = 17% g ← USGS/USAID [PREUM. EQ HAZARD MAP OF AFGHANISTAN]

SITE COEFFICIENT = 1.5 (SOIL PROFILE TYPE III) (TABLE 3.5.1 AASHTO)

SEISMIC FORCE = (695)(0.17)(1.5) = 177.23^k

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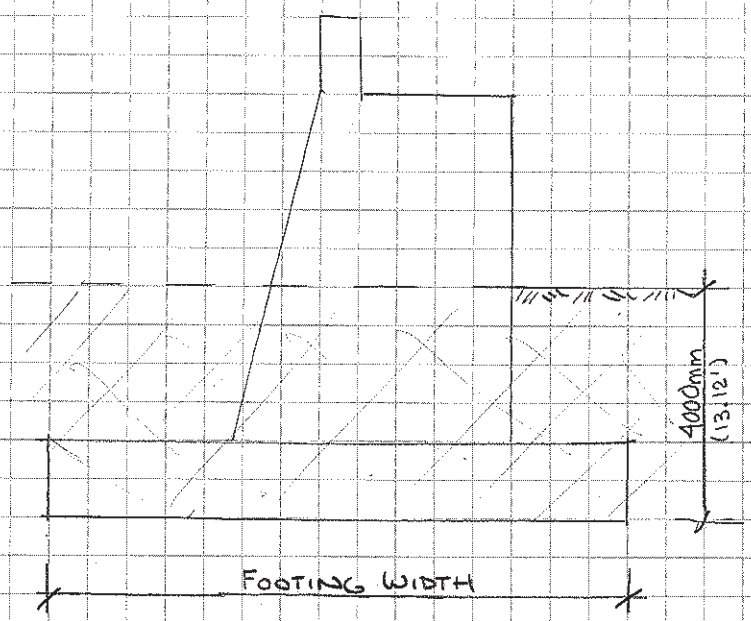
JOB KHOST BRIDGE
SHEET NO. SEISMIC LOADING OF
CALCULATED BY nav DATE 9/21/11
CHECKED BY JL DATE 9/27/11
SCALE

ALLOWABLE BEARING PRESSURE - ABUTMENT

NET ALLOWABLE = 6500 PSF (PER GEOTECHNICAL CALCULATIONS)



ALLOWABLE INCREASES TO BEARING PRESSURE:

BURIED PORTION OF SUBSTRUCTURE = (13.12)(118) = 1548

40% INCREASE @ TOE = (6500)*(1.40) = 9100

10,648 PSF

ALLOWABLE BEARING

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JOB KHOST BRIDGE

SHEET NO. B.P. ABUTMENT OF

CALCULATED BY nav DATE 9/22/11

CHECKED BY JZ DATE 9/27/11

SCALE

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ABUTMENT DESIGN

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Cantilever Abutment Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav/apl
Description:	USAID - Khost Bridge Type Study	**Checked By:**	jz
Structure:	Abutment Design	**Date:**	September 28, 2011

References:

AASHTO Standard Specification for Highways and Bridges, 17th Edition, 2002
ACI 318-05 Building Code Requirements for Structural Concrete, 2005

Notes:

General Design Parameters

GEOMETRY INFORMATION INPUT:

PROPOSED TOP OF ROADWAY ELEV:	3900.56	ft =	1188.890	m
PROPOSED BRIDGE SEAT ELEV:	3895.11	ft =	1187.231	m
PROPOSED TOP OF FOOTING ELEV:	3875.10	ft =	1181.131	m
PROPOSED BOT. OF FOOTING ELEV:	3871.82	ft =	1180.131	m
ELEVATION OF HIGH WATER:	3891.70	ft =	1186.190	m
PROPOSED BRIDGE SEAT WIDTH:	3.28	ft =	1.00	m
PROPOSED BACKWALL WIDTH:	0.98	ft =	0.30	m
ABUTMENT LENGTH:	31.17	ft =	9.50	m

MATERIAL PROPERTIES:

CUBIC WEIGHT CONCRETE:	150.00	Lbs/CF
COMP. STRENGTH OF CONC. = F'c:	4.00	ksi
TENSILE STRENGTH OF REBAR = Fy:	60.00	ksi

GEOTECHNICAL INFORMATION:

WEIGHT OF SOIL BACKFILL (STRATA 1):	118.00	Lbs/CF		
WEIGHT OF SOIL BACKFILL (STRATA 2):	118.00	Lbs/CF		
ALLOWABLE BEARING CAPACITY:	10.65	ksf		
WALL ON LEDGE:	N	(Y OR N)		
WALL ON PILES:	N	(Y OR N)		
BETA: SLOPE OF BACKFILL:	0.00	DEG	RAD =	0.0000
PHI: FRICTION ANGLE FOR SLIDING:	26.56	DEG	RAD =	0.4636
DELTA 1: ANGLE BACKWALL FRICTION:	17.00	DEG	RAD =	0.2967
DELTA 2: ANGLE BACKWALL FRICTION:	17.00	DEG	RAD =	0.2967
THETA: BATTER ANGLE BACKWALL:	90.00	DEG	RAD =	1.5708
PHI 1: FRICTION ANGLE OF BACKFILL:	27.00	DEG	RAD =	0.4712
PHI 2: FRICTION ANGLE OF BACKFILL:	27.00	DEG	RAD =	0.4712

Cantilever Abutment Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav/apl
Description:	USAID - Khost Bridge Type Study	**Checked By:**	jz
Structure:	Abutment Design	**Date:**	September 28, 2011

General Loading Parameters

LIVE LOAD INFORMATION:

APPROACH SLAB:	Y	(Y OR N)
ROADWAY WITHIN H/2 OF TOP OF WALL:	N	(Y OR N)
Live Load Surcharge to be Considered?:	N	
SURCHARGE HEIGHT:	0.00	ft
Construction Surcharge:	240.00	psf

Superstructure Loads: (see pier loading for back-up)

Superstructure DL (total at N abut) =	347.50	kips
Superstructure DL (total at S abut) =	347.50	kips
Superstructure LL (lane loading), per brg =		kips
Superstructure LL concentrated load) =		kips
Superstructure LL (total at South Abut) =		kips
Wind Load on Bridge=	0.00	kips
Wind Load on Abut (Conserv to Ignore, Opposite Earth) =	0.00	kips
Total Wind Load On Structure =	0.00	kips
Wind on Live Load =	2.46	kips
Superstructure LL concentrated load) =	0.00	kips
Longitudinal Force = (5% of Live Load)	4.20	kips

SEISMIC LOAD INFORMATION:

WALL RESTRAINED HORZ. MOVMT.(Y/N):	N	(Y OR N)***
SEISMIC ACCELERATION COEFF. A:	0.170	REF: FIG.32A Div IA, AASHTO
SEISMIC CATEGORY:	B	REF: Table 3.4 Div IA, AASHTO

***Superstructure has been designed to accommodate the movement required.

ADDITIONAL LOADS ON STRUCTURE (load is per linear foot of structure, arm from front edge of bridge seat)

	Beam 1 Rxn (kips)	Beam 2 Rxn (kips)	Beam 3 Rxn (kips)	Beam 4 Rxn (kips)	Beam 5 Rxn (kips)	Total Super Rxn (kips)	LOAD (klf)	ARM (feet)
SUPERSTRUCT. DEAD LOAD:						347.50	11.15	1.72
LIVE LOAD (NO IMPACT):						236.75	7.60	1.72
WIND LOAD ON STRUCTURE:						0.00	0.00	11.44
WIND LOAD ON LIVE LOAD:						2.46	0.08	11.44
LONGITUDINAL & FRICTION:						6.45	0.21	11.44
THERMAL FORCE:						9.63	0.31	0.36
SEISMIC LOAD ON SUPERSTRUCTURE:						177.23	5.69	3.50

Cantilever Abutment Design

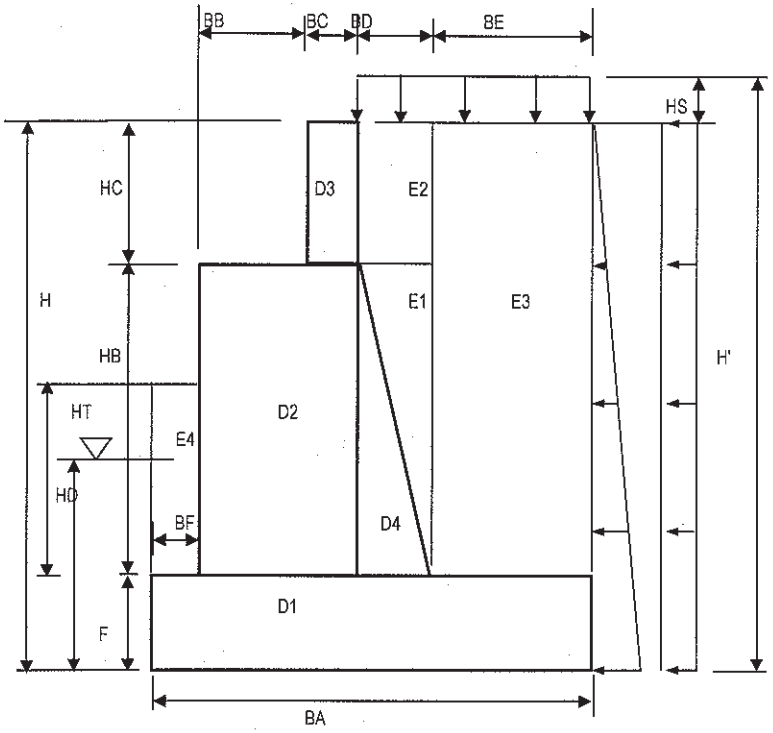
General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav/apl
Description:	USAID - Khost Bridge Type Study	**Checked By:**	jz
Structure:	Abutment Design	**Date:**	September 28, 2011

Abutment Geometry

CALCULATION OF WALL AND BACKFILL GEOMETRY:

	Prelim Size	User Adjust	Final Size	Final Size (m)
HEIGHT OF ABUTMENT / WALL, H:	28.737	0.00	28.74	8.759
HEIGHT OF FOOTING, F:	3.281	0.00	3.28	1.00
HEIGHT OF STEM, HB:	20.013	0.00	20.01	6.10
HEIGHT OF BACKWALL, HC:	5.443	0.00	5.44	1.659
HEIGHT OF HIGH WATER, HD:	19.879	0.00	19.88	6.06
HEIGHT OF SURCHARGE, HS:	0.000	0.00	0.00	0.00
THEORETICAL HEIGHT W/ SURCHARGE, H':	28.737	0.00	28.74	8.76
WIDTH OF FOOTING, BA:	15.000	6.33	21.33	6.50
WIDTH OF BRIDGE SEAT, BB:	3.281	0.00	3.28	1.00
WIDTH OF BACKWALL, BC:	0.984	0.00	0.98	0.30
WIDTH OF BATTER OF STEM, BD:	1.668	3.91	5.58	1.70
WIDTH OF FOOTING HEEL, BE	8.530	0.00	8.53	2.60
WIDTH OF FOOTING TOE, BF:	2.187	0.77	2.95	0.90
HEIGHT OF SOIL OVER TOE, HT:	0.000	14.76	14.76	4.50
HEIGHT OF SOIL (HT + F):	3.28	14.76	18.04	5.50



OVERALL QUANTITIES:

WEIGHT OF CONCRETE WALL/L.F.:	32.474	Kips per l.f.
CONCRETE QUANTITY / L.F.:	8.018	C.Y. per l.f.

Cantilever Abutment Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav/apl
Description:	USAID - Khost Bridge Type Study	**Checked By:**	jz
Structure:	Abutment Design	**Date:**	September 28, 2011

Results Summary:

STABILITY RESULTS:

GROUP:	I	II	III	IV	V	VI	VII	I-CON
OVERTURNING:	4.52	4.28	4.23	4.30	4.07	4.04	3.13	5.19
F.S.allowable = 2.00	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
SLIDING:	2.32	2.06	2.28	2.27	2.01	2.23	1.03	2.24
F.S.allowable = 1.50	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	***N.G.***	O.K.
Max BP (with Bouy):	5.65	4.70	5.79	5.75	4.79	5.88	5.40	4.96
Max BP (w/o Bouy):	10.08	9.12	10.21	10.17	9.22	10.30	9.82	4.96
ALLOWABLE:	10.65	13.31	13.31	13.31	14.91	14.91	14.19	10.65
Bear. Check:	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
Kern Check:	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.

SUMMARY OF QUANTITIES:

STEEL / L.F. =	450.230	LBS/L.F.
CONC. / L.F =	8.018	C.Y./L.F.

***Group VII Sliding - Was checked for 10 year flood (water elevation @ 1185.500 m) & seismic event has factor of safety of 1.16 <---OKAY

REINFORCEMENT RESULTS:

= As Provided / As Required

	STIRUP #	BAR #	SPAC.	REINF. RATIO	FLEX OK?	LBS./ L.F.	LENGTH OF BAR	No. Bars per ft	Wt. of bar PER L.F.	As/LF	SHEAR OK?		
TOE(bot):	0.00	8.00	12.00	1.38	OK	55.98	20.83	1.00	2.69	0.79	OK	7.00	6.00
HEEL(top):	0.00	8.00	6.00	1.12	OK	111.97	20.83	2.00	2.69	0.79	OK	7.00	5.00
STEM 1 (at top of ftg):	0.00	8.00	6.00	1.01	OK	39.14	7.28	2.00	2.69	0.79	OK	7.00	6.00
STEM 2 (at top of ftg dwl):	0.00	8.00	6.00	1.26	OK	70.82	13.17	2.00	2.69	0.79	OK	6.00	12.00
STEM 3 (midpt back face):	0.00	8.00	12.00	1.14	OK	35.41	13.17	1.00	2.69	0.79	OK	5.00	12.00
STEM 4 (at bot of bw):	0.00	5.00	12.00	1.39	OK	14.28	13.54	1.00	1.05	0.31	OK	5.00	12.00
STEM 5 (front face):	0.00	5.00	12.00	---	---	20.76	19.68	1.00	1.05	0.31		5.00	12.00
STEM 6 (front face dowels):	0.00	5.00	12.00	---	---	3.16	3.00	1.00	1.05	0.31		5.00	12.00
FOOTING (TOP):	0.00	5.00	12.00	---	---	22.50	1.00	21.33	1.05	0.31		5.00	12.00
FOOTING (BOT.)	0.00	5.00	12.00	---	---	22.50	1.00	21.33	1.05	0.31		5.00	12.00
STEM (longitudinal):	0.00	5.00	12.00	---	---	53.71	1.00	50.91	1.05	0.31		5.00	12.00
TOTAL WT. STEEL/FT OF ABUT.=						450.23	LBS./LF						

Cantilever Abutment Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav/apl
Description:	USAID - Khost Bridge Type Study	**Checked By:**	jz
Structure:	Abutment Design	**Date:**	September 28, 2011

Calculate Earth Pressure

These lateral earth pressure calculations include the effects of additional lateral earth pressure due to live load surcharge, if applicable.

Per AASHTO 3.20.3, when highway traffic can come within a horizontal distance from the top of the structure equal to 1/2 its height, the pressure shall have added to it a live load surcharge pressure equal to not less than 2 feet of earth. This surcharge is to be treated an an additional earth pressure.

Coulomb's Active Earth Pressure:

	STRATA 1			STRATA 2	
GAMMA =	118.00		GAMMA =	118.00	
H' =	28.74	Feet	H' =	28.74	Feet
THETA =	90.00	Degrees:	THETA =	90.00	Degrees:
BETA =	0.00	Degrees:	BETA =	0.00	Degrees:
PHI =	27.00	Degrees:	PHI =	27.00	Degrees:
DELTA =	17.00	Degrees:	DELTA =	17.00	Degrees:
Ka (1) =	**0.335**		**Ka (2) =**	**0.335**	

At-Rest Earth Pressure Coeff:

	STRATA 1		STRATA 2
Ko (1) =	**0.546**	**Ko (2) =**	**0.546**

Cantilever Abutment Design

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Calculate Earth Pressure (cont.)

Earth Pressure Coefficient to be Used for Design:

Design of walls on rock or piles shall use Ko. Cantilever walls shall use Ka. Active Pressure coefficients shall be estimated using Coulomb Theory.

WALL ON LEDGE:	N	(Y OR N)
WALL ON PILES:	N	(Y OR N)
Wall Height:	28.74	ft
Earth pressure Type:	Ka	

	STRATA 1		STRATA 2
Ke (1) =	0.335	**Ke (2) =**	0.335

Pi(h) =1/2(Ke)(Gamma)(hi^2)cos(90-theta+delta)
Pi(v) =1/2(Ke)(Gamma)(hi^2)sin(90-theta+delta)

Compute Earth Loads and Moments:

	hi	Kai	Gamma	Fi	Pi	DELTA	Pi(h)	ARM	Mi	Pi(v)	ARM	Mi
1	0.00	0.335	118.00	0.000	0.00	17.00	0.00	28.74	0.00	0.00	21.33	0.00
2	28.74	0.335	118.00	0.000	0.00	17.00	0.00	14.37	0.00	0.00	21.33	0.00
3	28.74	0.335	118.00	1.136	16.32	17.00	15.61	9.58	149.51	4.77	21.33	101.76
SUM =					**16.32**		**15.61**	**9.58**	**149.51**	**4.77**	**21.33**	**101.76**

Earth Pressure Coefficient to be Used for Design per Geotechnical Recommendations:

n/a

EFPa, Above Water =	0.00	pcf
EFPb, Below Water =	0.00	pcf
Wall Height, H:	28.7368776	ft
H Under Water, HD=	19.8786096	ft
H Above Water, H1=	8.858268	ft

Cantilever Abutment Design

General Information

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Calculate Earth Pressure (cont.)

Pi(h) =1/2(EFP)(hi^2)
Pi(v) =0

Compute Earth Loads and Moments per Geotech Report:

	hi	Kai	Gamma	Fi	Pi	DELTA	Pi(h)	ARM	Mi	Pi(v)	ARM	Mi
1	8.86	0.546	118.00	0.000	0.00		0.00	22.83	0.00			
2	19.88	0.546	118.00	0.000	0.00		0.00	9.94	0.00			
3	19.88	0.546	118.00	0.000	0.00		0.00	6.63	0.00			
SUM =					**0.00**		**0.00**	**9.58**	**0.00**			

SUMMARY AND RESULTANT OF EARTH PRESSURES (to be used for design):

	FORCE (Kips)	ARM (Feet)	MOM (Ft x K)
Pa(v) =	4.77	21.33	101.76
Pa(h) =	15.61	9.58	149.51
Pa =	**16.321**		

Cantilever Abutment Design

General Information

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Calculate Seismic Forces

(Ref: AASHTO DIV1A, Section 6.4 and 1998 Commentary C6.4.3 for Mononobe-Okabe Analysis.)

	STRATA 1				STRATA 2			
GAMMA =	118.00	Lbs/CF			118.00	Lbs/CF		
H =	28.74	Feet			28.74	Feet		
PHI =	27.00	Degrees =	0.47	Radians	27.00	Degrees =	0.47	Radians
THETA =	4.86	Degrees =	0.08	Radians	4.86	Degrees =	0.08	Radians
DELTA =	17.00	Degrees =	0.30	Radians	17.00	Degrees =	0.30	Radians
A =	0.17				0.17			
kh =	0.085				0.085			
i =	0.00	Degrees =	0.00	Radians	0.00	Degrees =	0.00	Radians
BETA =	0.00	Degrees =	0.00	Radians	0.00	Degrees =	0.00	Radians

SEISMIC ACTIVE EARTH PRESSURE (AASHTO 1998 Commentary, C6.4.3)

Kae (1) = 0.396 **Kae (2) =** 0.396

Compute Seismic Loads and Moments:

	hi	Kai	Gamma	Fi	Pi	DELTA	Pi(h)	ARM	Mi	Pi(v)	ARM	Mi
1	0.00	0.396	118.00	0.000	0.00	17	0.00			0.00		
2	28.74	0.396	118.00	0.000	0.00	17	0.00			0.00		
3	28.74	0.396	118.00	1.342	19.28	17	18.44			5.64		
SUM =					**19.28**		**18.44**	**14.37**	**264.94**	**5.64**	**21.33**	**120.22**

RESULTANT OF SEISMIC EARTH PRESSURE: (AASHTO 1998 Commentary, C6.4.3)

Pae = GAMMAxKaH^2/2 =

Eae=Pae = 19.281 Kips

ASSUME Pae ACTS AT H/2 = 14.368 ft

Cantilever Abutment Design

General Information

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Structure:	Abutment Design	**Date:**	September 28, 2011

Calculate Seismic Forces (cont.)

WALL INERTIA EFFECTS

Per AASHTO DIV 1A 6.4.3, seismic design should take into account forces arising from seismically inducd lateral earth pressures (as computed above), additional forces arising from wall inertia and the transfer of seismic forces from the bridge deck through bearing supports which do not slide freely.

The following table computes the inertia forces due to the weight of the concrete and backfill.

kh = **0.085**

	AREA #	DL (Kips)	DL*kh (Kips)	ARM (Feet)	MOM (Ft x K)
DL Wall	D1	10.49	0.89	1.64	1.46
	D2	12.80	1.09	13.29	14.46
	D3	0.80	0.07	26.02	1.78
	D4	8.37	0.71	9.95	7.08
	D5	0.00	0.00		0.00
	Subtotal	**32.47**	**2.76**	**8.98**	**24.78**
DL Backfill	E1	6.59	0.56	16.62	9.31
	E2	3.58	0.30	26.02	7.92
	E3	26.62	2.18	16.01	34.87
	E4	5.14	0.44	10.66	4.66
	Subtotal	**40.94**	**3.48**	**16.31**	**56.76**
TOTAL		**73.41**	**6.24**	**13.07**	**81.54**

SUMMARY OF SEISMIC LOADS:

	FORCE (Kips)	ARM (Feet)	MOM (Ft x K)
Pae(v) = Pae x SIN(90-TH+DEL) =	5.64	21.33	120.22
Pae(h) = Pae x COS(90-TH+DEL) =	18.44	14.37	264.94
Fwi(h) = kh x Wbackfill =	6.24	13.07	81.54
EQ Superstructure =	5.69	26.79	152.35

Cantilever Abutment Design

General Information

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Structure:	Abutment Design	**Date:**	September 28, 2011

Construction Surcharge

Per the Geotechnical Report, consider the following surcharge during construction.

q =	240.00	psf
Uniform Load on Wall, p=Ke*q =	0.080	psf
Wall Height, H =	28.74	Feet
Heel Length, BE =	8.53	Feet
Footing Width, BA =	21.33	Feet
Wall Length Considered =	1.00	ft
Pcon(h) = p*H*Length =	2.31	kips
MconOT = Pconh*H/2 =	33.19	kip*ft
Pcon(v) = q*BE*Length =	2.05	kips
MconR = Pconv*(BA-BE/2) =	34.93	kip*ft

Loads from Superstructure

	FORCE (Kips)	ARM (Feet)	MOM (Ft x K)
DL	11.15	4.67	52.10
LL	7.60	4.67	35.49
W	0.00	34.74	0.00
WL	0.08	34.74	2.74
LF	0.21	34.74	7.19
T	0.31	23.65	7.31
EQ	Included in EQ Calcs Above		

Cantilever Abutment Design

General Information

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Structure:	Abutment Design	**Date:**	September 28, 2011

Buoyancy Forces

Note: Since the Saturated Unit Weight of water was not included in the Dead Load calculations, it is included here. In the calcs below, B1 is the bouyant force due to the footing, B2 is the bouyant force due to the stem and B3 is the bouyant force on the saturated soil. Since the geotech did not provide a saturated unti weight of soil, the dry unit weight is used. This is conservative.

HEIGHT OF STEM AT HIGH WATER:	16.60	
HEIGHT OF FOOTING AT HIGH WATER:	3.28	
WIDTH OF FOOTING	21.33	
SOIL WEIGHT - WATER WEIGHT	-62.40	pcf
UPWARD BOUYANT FORCE	-62.40	pcf

NOTE: If the Geotech approach to Earth Pressure governed, the lateral effects of Bouyancy have already been considered.

VERTICAL:

AREA #	VOLUME (CF)	GAMMA (#/CF)	Force (Kips)	Arm (Feet)	Moment (Ft x K)
B1	69.97	-62.40	-4.37	10.66	-46.55
B2	163.36	-62.40	-10.19	5.09	-51.84
B3	251.55	-62.40	-15.70	15.23	-239.02
B4	3.77	-62.40	-0.24	1.48	-0.35
SUM =			**-30.49**		**-337.76**

HORIZONTAL:

Force = B(h) = (62.4-Ka*62.4)H^2/2, acts at HD/3:

AREA #	Force (Kips)	Arm (Feet)	Moment (Ft x K)
STATIC	8.20	6.63	54.33
SEISMIC	7.45	6.63	49.36
SUM =	**15.65**		**103.69**

Cantilever Abutment Design

General Information

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Description:	USAID - Khost Bridge Type Study	**Checked By:**	jz
Structure:	Abutment Design	**Date:**	September 28, 2011

Service Load Group Summary - Group I

GROUP I: DL+LL+E+B

	AREA #	VOLUME (CF)	GAMMA (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	D1	69.97	150.00	10.49	10.66	111.90			
	D2	85.36	150.00	12.80	5.09	65.11			
	D3	5.36	150.00	0.80	6.73	5.40			
	D4	55.81	150.00	8.37	9.08	75.99			
	D5		150.00	0.00		0.00			
	Subtotal Concrete			**32.47**		**258.41**			
	E1	55.81	118.00	6.59	10.94	72.02			
	E2	30.36	118.00	3.58	10.01	35.85			
	E3	217.14	118.00	25.62	17.06	437.14			
	E4	43.59	118.00	5.14	1.48	7.59			
	Subtotal Earth			**40.94**		**552.60**			
	Superstructure			**11.15**	**4.67**	**52.10**			
	TOTAL DL			**84.56**		**863.11**			
LL	**Superstructure**			7.60	4.67	35.49			
	TOTAL LL			**7.60**		**35.49**			
E	Pa(v) =			4.77	21.33	101.76			
	Pa(h) =						15.61	9.58	149.51
	Surch.	0.00	118.00	0.00	14.27	0.00			
	TOTAL E			**4.77**		**101.76**	**-4.56**		**28.18**
B	B1(v) =			-4.37	10.66	-46.55			
	B2(v) =			-10.19	5.09	-51.84			
	B3(v) =			-15.70	15.23	-239.02			
	B(h) =						8.20	6.63	54.33
	TOTAL B			**-30.49**		**-337.76**	**18.87**		**118.49**
SUM				**66.43**		**662.60**	**14.30**		**146.67**

Passive Pressure Side Calc:

Height:	18.04	ft
Kp:	2.10	(per Geotech Report)
Reduction factor	0.50	
Gamma: (Dry)	118.00	lb/ft^3
Horizontal Force: (Dry)	-20.17	kips**
Arm:	6.01	ft
Overturning Moment: (Dry)	-121.33	ft-kip**
Gamma: (submerged)	55.60	lb/ft^3
Gamma: (difference)	-62.40	lb/ft^3
Horizontal Force: (B)	10.67	kips**
Arm:	6.01	ft
Overturning Moment: (B)	64.16	ft-kip**

** Add overturning moment due to Passive Earth Pressure to Active Earch Pressure.

* Add to bouyancy to account for case when passive earth pressure is submerged

Cantilever Abutment Design

General Information

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Description:	USAID - Khost Bridge Type Study	**Checked By:**	jz
Structure:	Abutment Design	**Date:**	September 28, 2011

Service Load Group Summary - Group II & III

GROUP II: DL+E+B+W

	AREA #	VOLUME (CF)	GAMMA (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	**TOTAL DL**			**84.56**		**863.11**			
E	**TOTAL E**			**4.77**		**101.76**	**-4.56**		**28.18**
B	**TOTAL B**			**-30.49**		**-337.76**	**18.87**		**118.49**
W	Superstructure						0.00	34.74	0.00
	TOTAL W						**0.00**		**0.00**
SUM				**58.84**		**627.11**	**14.30**		**146.67**

GROUP III: DL+LL+E+B+0.3*W+WL+LF

	AREA #	VOLUME (CF)	GAMMA (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	**TOTAL DL**			**84.56**		**863.11**			
LL	**TOTAL LL**			**7.60**		**35.49**			
E	**TOTAL E**			**4.77**		**101.76**	**-4.56**		**28.18**
B	**TOTAL B**			**-30.49**		**-337.76**	**18.87**		**118.49**
W	**TOTAL W**						**0.00**		**0.00**
WL	Superstructure						0.08	34.74	2.74
	TOTAL WL						**0.08**		**2.74**
LF	Superstructure						0.21	34.74	7.19
	TOTAL LF						**0.21**		**7.19**
SUM				**66.43**		**662.60**	**14.59**		**156.60**

Cantilever Abutment Design

General Information

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Description:	USAID - Khost Bridge Type Study	**Checked By:**	jz
Structure:	Abutment Design	**Date:**	September 28, 2011

Service Load Group Summary - Group IV, V & VI

GROUP IV: GROUP I + T

	AREA #	VOLUME (CF)	GAMMA (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
TOTAL GROUP I				**66.43**		**662.60**	**14.30**		**146.67**
T	Superstructure						0.31	23.65	7.31
	TOTAL T						**0.31**		**7.31**
SUM				**66.43**		**662.60**	**14.61**		**153.97**

GROUP V: GROUP II + T

	AREA #	VOLUME (CF)	GAMMA (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
TOTAL GROUP II				**58.84**		**627.11**	**14.30**		**146.67**
T	Superstructure						0.31	23.65	7.31
	TOTAL T						**0.31**		**7.31**
SUM				**58.84**		**627.11**	**14.61**		**153.97**

GROUP VI: GROUP III + T

	AREA #	VOLUME (CF)	GAMMA (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
TOTAL GROUP III				**66.43**		**662.60**	**14.59**		**156.60**
T	Superstructure						0.31	23.65	7.31
	TOTAL T						**0.31**		**7.31**
SUM				**66.43**		**662.60**	**14.90**		**163.90**

Cantilever Abutment Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav/apl
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Structure:	Abutment Design	**Date:**	September 28, 2011

Service Load Group Summary - Group VII & I (during construction)

GROUP VII: DL+E+B+EQ

	AREA #	VOLUME (CF)	GAMMA (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	**TOTAL DL**			**84.56**		**863.11**			
E	**TOTAL E**			The earth pressure effects are included in EQ load.					
B	**TOTAL B**			**-30.49**		**-337.76**	**18.87**		**118.49**
EQ	Pae(v)			5.64	21.33	120.22			
	Pae(h)						-1.73	14.37	-146.22
	Fwi						6.24	13.07	81.54
	Superstructure						5.69	26.79	152.35
	TOTAL EQ			**5.64**		**120.22**	**10.19**		**87.67**
SUM				**59.70**		**645.56**	**29.06**		**206.16**

GROUP I: DL+E - DURING CONSTRUCTION

	AREA #	VOLUME (CF)	GAMMA (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	Subtotal Concrete			32.47		258.41			
	Subtotal Earth			40.94		552.60			
	TOTAL DL			**73.41**		**811.01**			
E	Pa(v) =			4.77	21.33	101.76			
	Pa(h) =						15.61	9.58	149.51
	TOTAL E			**4.77**		**101.76**	**15.61**		**149.51**
SURCH				**2.05**		**34.93**	**2.31**		**33.19**
SUM				**80.23**		**947.70**	**17.92**		**182.70**

Cantilever Abutment Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav/apl
Description:	USAID - Khost Bridge Type Study	**Checked By:**	jz
Structure:	Abutment Design	**Date:**	September 28, 2011

Check Overturning

CHECK OVERTURNING: (F.S. > 2.0) (F.S>1.5 for Group VII) (REF AASHTO 5.5.5)

GROUP I:							
FS(overturning) =	SUM Mr	=	662.60	=	4.52	>2.0	O.K.
	Mo		146.67				
GROUP II:							
FS(overturning) =	SUM Mr	=	627.11	=	4.28	>2.0	O.K.
	Mo		146.67				
GROUP III:							
FS(overturning) =	SUM Mr	=	662.60	=	4.23	>2.0	O.K.
	Mo		156.60				
GROUP IV:							
FS(overturning) =	SUM Mr	=	662.60	=	4.30	>2.0	O.K.
	Mo		153.97				
GROUP V:							
FS(overturning) =	SUM Mr	=	627.11	=	4.07	>2.0	O.K.
	Mo		153.97				
GROUP VI:							
FS(overturning) =	SUM Mr	=	662.60	=	4.04	>2.0	O.K.
	Mo		163.90				
GROUP VII:							
FS(overturning) =	SUM Mr	=	645.56	=	3.13	>1.5	O.K.
	Mo		206.16				
	Mo		0.00				
GROUP I - CONSTRUCTION:							
FS(overturning) =	SUM Mr	=	947.70	=	5.19	>1.0	O.K.
	Mo		182.70				

Cantilever Abutment Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav/apl
Description:	USAID - Khost Bridge Type Study	**Checked By:**	jz
Structure:	Abutment Design	**Date:**	September 28, 2011

Check Sliding

CHECK SLIDING: (F.S. > 1.5) (F.S. >1.125 for Group VII)

F.S.(sliding) = Sum V * Tan(phi) / Sum H

GROUP I:	66.43	*	0.500	=	**2.32**	**> 1.5 OK**
FS(sliding) =			14.30			
GROUP II:	58.84	*	0.500	=	**2.06**	**> 1.5 OK**
FS(sliding) =			14.30			
GROUP III:	66.43	*	0.500	=	**2.28**	**> 1.5 OK**
FS(sliding) =			14.59			
GROUP IV:	66.43	*	0.500	=	**2.27**	**> 1.5 OK**
FS(sliding) =			14.61			
GROUP V:	58.84	*	0.500	=	**2.01**	**> 1.5 OK**
FS(sliding) =			14.61			
GROUP VI:	66.43	*	0.500	=	**2.23**	**> 1.5 OK**
FS(sliding) =			14.90			
GROUP VII:	59.70	*	0.500	=	**1.03**	**< 1.125, ***NG*****
FS(sliding) =			29.06			
GROUP I - CONSTRUCTION:	80.23	*	0.500	=	**2.24**	**> 1.0 OK**
FS(sliding) =			17.92			

Cantilever Abutment Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav/apl
Description:	USAID - Khost Bridge Type Study	**Checked By:**	jz
Structure:	Abutment Design	**Date:**	September 28, 2011

Check Bearing Pressure

* - indicates the effect of buoyancy has been neglected.

GROUP :	I	II	III	IV	V	VI	VII	I-CON
Q =	66.43	58.84	66.43	66.43	58.84	66.43	59.70	80.23
Bv =	-30.49	-30.49	-30.49	-30.49	-30.49	-30.49	-30.49	
Q* =	96.93	89.33	96.93	96.93	89.33	96.93	90.20	80.23
Mr =	662.60	627.11	662.60	662.60	627.11	662.60	645.56	947.70
Mo =	146.67	146.67	156.60	153.97	153.97	163.90	206.16	182.70
Mnet =	515.93	480.44	506.00	508.63	473.13	498.69	439.41	764.99
Mb =	-98.39	-98.39	-98.39	-98.39	-98.39	-98.39	-98.39	
Mr* =	760.99	725.50	760.99	760.99	725.50	760.99	743.95	947.70
Mnet* =	614.32	578.83	604.39	607.02	571.52	597.09	537.80	764.99
e =	2.90	2.50	3.05	3.01	2.62	3.16	3.30	1.13
e* =	4.32	4.18	4.43	4.40	4.26	4.50	4.70	1.13
B/6 =	3.55	3.55	3.55	3.55	3.55	3.55	3.55	3.55
qheel =	0.58	0.82	0.45	0.48	0.72	0.35	0.20	2.57
qtoe =	5.65	4.70	5.79	5.75	4.79	5.88	5.40	4.96
qheel* =	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.57
qtoe* =	10.08	9.12	10.21	10.17	9.22	10.30	9.82	4.96
Allowable =	10.65	13.31	13.31	13.31	14.91	14.91	14.19	10.65
Kern (all) =	3.55	3.55	3.55	3.55	3.55	3.55	7.11	7.11
Bear. Check:	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
Kern Check:	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.

Cantilever Abutment Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav/apl
Description:	USAID - Khost Bridge Type Study	**Checked By:**	jz
Structure:	Abutment Design	**Date:**	September 28, 2011

Factored Load Group Summary - Group I & II

Per AASHTO Table 3.22.1A, for Load Factor Design, β_E = 1.3

GROUP I: 1.3*(DL+1.67*LL+E+B)

	AREA #	VOLUME (CF)	GAMMA (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	**TOTAL DL**			**84.56**		**863.11**			
1.67*LL	**TOTAL LL**			**12.69**		**59.27**			
E	Pa(v) =			4.77	21.33	101.76			
	β_E*Pa(h) =						20.29	12.45	194.36
	Surch.	0.00	118.00	0.00	14.27	0.00			
	TOTAL E			**4.77**		**101.76**	**20.29**		**194.36**
B	**TOTAL B**			**-30.49**		**-337.76**	**18.87**		**118.49**
SUM				**92.98**		**892.29**	**50.90**		**406.70**

GROUP II: 1.3(DL+E+B+W)

	AREA #	VOLUME (CF)	GAMMA (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	**TOTAL DL**			**84.56**		**863.11**			
E	**TOTAL E**			**4.77**		**101.76**	**20.29**		**194.36**
B	**TOTAL B**			**-30.49**		**-337.76**	**18.87**		**118.49**
W	Superstructure						0.00	34.74	0.00
	TOTAL W						**0.00**		**0.00**
SUM				**76.49**		**815.24**	**50.90**		**406.70**

Cantilever Abutment Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav/apl
Description:	USAID - Khost Bridge Type Study	**Checked By:**	jz
Structure:	Abutment Design	**Date:**	September 28, 2011

Factored Load Group Summary - Group III & IV

GROUP III: 1.3(DL+LL+E+B+0.3*W+WL+LF)

	AREA #	VOLUME (CF)	GAMMA (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	**TOTAL DL**			**84.56**		**863.11**	**0.00**		**0.00**
LL	**TOTAL LL**			**7.60**		**35.49**	**0.00**		**0.00**
E	**TOTAL E**			**4.77**		**101.76**	**20.29**		**194.36**
B	**TOTAL B**			**-30.49**		**-337.76**	**18.87**		**118.49**
W	**TOTAL W**						**0.00**		**0.00**
WL	Superstructure						0.08	34.74	2.74
	TOTAL WL						**0.08**	**0.00**	**2.74**
LF	Superstructure						0.21	34.74	7.19
	TOTAL LF						**0.21**	**0.00**	**7.19**
SUM				**86.36**		**861.38**	**51.27**		**419.61**

GROUP IV: 1.3*(DL+LL+E+B+T)

	AREA #	VOLUME (CF)	GAMMA (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	**TOTAL DL**			**84.56**		**863.11**			
LL	**TOTAL LL**			**7.60**		**35.49**			
E	Pa(v) =			4.77		101.76			
	1.3*Pa(h) =						20.29	12.45	194.36
	Surch.	0.00	118.00	0.00	14.27	0.00			
	TOTAL E			**4.77**		**101.76**	**20.29**		**194.36**
B	**TOTAL B**			**-30.49**		**-337.76**	**18.87**		**118.49**
T	Superstructure						0.31	23.65	7.31
	TOTAL T						**0.31**		**7.31**
SUM				**86.36**		**861.38**	**51.30**		**416.20**

Cantilever Abutment Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav/apl
Description:	USAID - Khost Bridge Type Study	**Checked By:**	jz
Structure:	Abutment Design	**Date:**	September 28, 2011

Factored Load Group Summary - Group V, VI & VII

GROUP V: GROUP II * (1.25/1.30) + 1.25*T

	AREA #	VOLUME (CF)	GAMMA (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
TOTAL GROUP II				**76.49**		**815.24**	**50.90**		**406.70**
T	Superstructure						0.31	23.65	7.31
	TOTAL T						**0.31**		**7.31**
SUM				**73.55**	**0.00**	**783.88**	**49.33**	**0.00**	**400.19**

GROUP VI: GROUP III * (1.25/1.30) + 1.25*T

	AREA #	VOLUME (CF)	GAMMA (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
TOTAL GROUP III				**86.36**		**861.38**	**51.27**		**419.61**
T	Superstructure						0.31	23.65	7.31
	TOTAL T						**0.31**		**7.31**
SUM				**83.04**	**0.00**	**828.25**	**49.69**	**0.00**	**412.61**

GROUP VII: 1.3*(DL+E+B+EQ)

	AREA #	VOLUME (CF)	GAMMA (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	**TOTAL DL**			**84.56**		**863.11**			
E	**TOTAL E**			The earth pressure effects are included in EQ load.					
B	**TOTAL B**			**-30.49**		**-337.76**	**18.87**		**118.49**
EQ	**TOTAL EQ**			**5.64**		**120.22**	**10.19**		**87.67**
SUM				**77.61**		**839.23**	**37.78**		**268.00**

Cantilever Abutment Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav/apl
Description:	USAID - Khost Bridge Type Study	**Checked By:**	jz
Structure:	Abutment Design	**Date:**	September 28, 2011

Factored Toe Moment Calculation

* - indicates the effect of buoyancy has been neglected.

GROUP :	I	II	III	IV	V	VI	VII
Q =	92.98	76.49	86.36	86.36	73.55	83.04	77.61
Bv =	-39.64	-39.64	-39.64	-39.64	-38.11	-38.11	-39.64
Q* =	132.62	116.13	126.00	126.00	111.66	121.16	117.25
Mr =	892.29	815.24	861.38	861.38	783.88	828.25	839.23
Mo =	406.70	406.70	419.61	416.20	400.19	412.61	268.00
Mnet =	485.59	408.54	441.77	445.18	383.69	415.64	571.23
Mb =	-439.09	-439.09	-39.64	-39.64	-38.11	-422.20	-439.09
Mr* =	1331.38	1254.33	901.02	901.02	822.00	1250.45	1278.32
Mnet* =	924.68	847.63	481.41	484.82	421.80	837.84	1010.32
e =	5.44	5.32	5.55	5.51	5.45	5.66	3.30
e* =	3.69	3.36	6.84	6.82	6.89	3.75	2.05
B/6 =	3.55	3.55	3.55	3.55	3.55	3.55	3.55
qheel =	0.00	0.00	0.00	0.00	0.00	0.00	0.26
qtoe =	11.87	9.55	11.26	11.17	9.40	11.06	7.02
B' =	15.67	16.02	15.35	15.46	15.65	15.02	21.33
q2 =	9.63	7.79	9.09	9.04	7.63	8.89	6.09
Mtoe =	48.49	39.06	45.92	45.59	38.40	45.06	29.25
Vtoe =	31.74	25.59	30.04	29.83	25.13	29.45	19.35
qheel* =	0.00	0.29	0.00	0.00	0.00	0.00	2.33
qtoe* =	12.68	10.60	17.28	17.24	15.38	11.67	8.66
B'* =	20.92	21.33	11.46	11.54	11.33	20.75	21.33
q2* =	10.89	9.17	12.83	12.83	11.37	10.01	7.79
Mtoe* =	52.66	44.13	68.87	68.74	61.22	48.47	36.49
Vtoe* =	34.79	29.19	44.46	44.39	39.50	32.01	24.29

Max. Toe Moment =	**68.873**	kip*ft
Max. Toe Shear =	**44.459**	kips

Cantilever Abutment Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav/apl
Description:	USAID - Khost Bridge Type Study	**Checked By:**	jz
Structure:	Abutment Design	**Date:**	September 28, 2011

Design Toe Reinforcement

DESIGN FOOTING TOE REINF (BOTTOM BARS):
(REF: AASHTO: 8.16.1.2, 8.16.3.2, 8.17.1)

Mu =	68.87	kip*ft
ASSUME COVER =	3.00	in.
HEIGHT FOOTING: h =	3.28	ft
phi =	0.90	
f'c =	4.00	ksi
fy =	60.00	ksi
d =	35.87	in. = h - cover - 1/2db(main) -db(stirup)
Sx =	3100.01	in^3
fcr =	474.34	psi
1.2*Mcr =	147.05	kip ft
a = Asfy/0.85f'cb =	1.16	in.
phi*Mn =	125.45	= phi[Asfy(d-a/2)]/12 kip ft.
As required for Mu:	0.4304	in^2
Min As (#4@18"):	0.1333	in^2
As(req'd) =	0.57 <	0.79 OK
USE #	8.00 @	12.00 IN

	Bar #	As(bar)	db	Spg (in)	As prov (in^2)
Stirrup	0.00	0.00	0.00		
Flexural	8.00	0.79	1.00	12.00	0.79

CHECK SHEAR CAPACITY OF CONCRETE: (AASHTO 8.16.6.2)

Vc = 2*f'c^.5*bw*d

f'c =	4.00	
d =	35.87	
bw =	12.00	(per linear ft of heel)
phi =	0.85	
Vu =	44.46	kips
PHI*Vc =	46.28	O.K.

Cantilever Abutment Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav/apl
Description:	USAID - Khost Bridge Type Study	**Checked By:**	jz
Structure:	Abutment Design	**Date:**	September 28, 2011

Factored Heel Moment Calculation

GROUP	I	II	III	IV	V	VI	VII
E3 =	33.31	33.31	33.31	33.31	32.03	32.03	33.31
arm = BE/2 =	4.27	4.27	4.27	4.27	4.27	4.27	4.27
M3 = E3*arm =	142.07	142.07	142.07	142.07	136.61	136.61	142.07
Surcharge=	0.00	0.00	0.00	0.00	0.00	0.00	0.00
arm = BE/2 =	4.27	4.27	4.27	4.27	4.27	4.27	4.27
MSUR = SUR*arm =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HEEL CONC. =	5.46	5.46	5.46	5.46	5.46	5.46	5.46
arm = BE/2 =	4.27	4.27	4.27	4.27	4.27	4.27	4.27
Mconc. =	23.28	23.28	23.28	23.28	23.28	23.28	23.28
Pa(v) =	6.20	6.20	6.20	6.20	5.96	5.96	7.33
arm = BE	8.53	8.53	8.53	8.53	8.53	8.53	8.53
Mpv =	52.92	52.92	52.92	52.92	50.88	50.88	62.51
Vu =	44.97	44.97	44.97	44.97	43.45	43.45	46.10
Mheel(top) =	218.26	218.26	218.26	218.26	210.76	210.76	227.86

Max. Heel Moment = **227.860** kip*ft

Max. Heel Shear = **46.096** kips

Cantilever Abutment Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav/apl
Description:	USAID - Khost Bridge Type Study	**Checked By:**	jz
Structure:	Abutment Design	**Date:**	September 28, 2011

Design Heel Reinforcement

DESIGN FOOTING HEEL REINF (TOP BARS):

Mu =	227.86	kip*ft
ASSUME COVER =	2.00	in.
HEIGHT FOOTING: h =	3.28	ft
phi =	0.90	
f'c =	4.00	ksi
fy =	60.00	ksi
d =	36.87	in. = h - cover - 1/2db(main) -db(stirup)
Sx =	3100.01	in^3
fcr =	474.34	psi
1.2*Mcr =	147.05	kip ft
a = Asfy/0.85f'cb =	2.32	in.
phi*Mn =	253.89	= phi[Asfy(d-a/2)]/12 kip ft.
As required for Mu:	1.4130	in^2
Min As (#4@18"):	0.1333	in^2
As(req.) =	1.41 < 1.58	OK
USE #	8.00 @ 6.00	IN

	Bar #	As(bar)	db	Spg (in)	As prov (in^2)
Stirrup	0.00	0.00	0.00		
Flexural	8.00	0.79	1.00	6.00	1.58

CHECK SHEAR CAPACITY OF CONCRETE: (AASHTO 8.16.6.2)

Vc = 2*f'c^.5*bw*d

f'c =	4.00	
d =	36.87	
bw =	12.00	(per linear ft of heel)
phi =	0.85	
Vu =	46.10	kips
PHI*Vc =	47.57	O.K.

Cantilever Abutment Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav/apl
Description:	USAID - Khost Bridge Type Study	**Checked By:**	jz
Structure:	Abutment Design	**Date:**	September 28, 2011

Compute the Lateral Loads on the Stem at Various Heights

Check the stem reinforcement at various locations along the stem and at the base of the backwall.

Height of Stem plus Backwall, h = H - F =	25.46	ft
Height of Backwall =	5.44	ft
Ftg Dowel Lap Length:	3.50	ft
Width of Stem at the Base:	9.84	ft
Width of Backwall:	0.98	ft
Width of Batter:	5.58	ft

Height of h	Height from top	Width Batter	Width conc	
1.00	25.46	5.58	9.84	<=== This section is at the bottom of the stem.
0.86	21.96	4.60	8.87	<=== This section is at the top of the footing dowel.
0.54	13.70	2.30	6.57	<=== This section is halfway in between top of footing dowel and top of batter.
0.21	5.44		0.98	<=== This section is at the base of the backwall

Cantilever Abutment Design

General Information

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Description:	USAID - Khost Bridge Type Study	**Checked By:**	jz
Structure:	Abutment Design	**Date:**	September 28, 2011

Compute the Lateral Loads on the Stem at Various Heights (cont.)

CALCULATE EARTH PRESSURES AT EACH HEIGHT:

h =	25.46					
hi	Kai	Gamma	Fi	Pi(h)	ARM	M
0	0.33	118.000	0.00	0.000	25.46	0.00
25.4560377	0.33	118.000	0.00	0.000	12.73	0.00
25.4560377	0.33	118.000	1.01	12.247	8.49	103.92
SUM =				**12.25**	**8.49**	**103.92**

h =	21.96					
hi	Kai	Gamma	Fi	Pi(h)	ARM	M
0	0.33	118.000	0.00	0.000	21.96	0.00
21.9560377	0.33	118.000	0.00	0.000	10.98	0.00
21.9560377	0.33	118.000	0.87	9.111	7.32	66.68
SUM =				**9.11**	**7.32**	**66.68**

h =	13.70					
hi	Kai	Gamma	Fi	Pi(h)	ARM	M
0	0.33	118.000	0.00	0.000	13.70	0.00
13.6994756	0.33	118.000	0.00	0.000	6.85	0.00
13.6994756	0.33	118.000	0.54	3.547	4.57	16.20
SUM =				**3.55**	**4.57**	**16.20**

h =	5.44					
hi	Kai	Gamma	Fi	Pi(h)	ARM	M
0	0.33	118.000	0.00	0.000	5.44	0.00
5.44291356	0.33	118.000	0.00	0.000	2.72	0.00
5.44291356	0.33	118.000	0.22	0.560	1.81	1.02
SUM =				**0.56**	**1.81**	**1.02**

CALCULATE SEISMIC PRESSURES AT EACH HEIGHT:

h =	25.46					
hi	Kai	Gamma	Fi	Pae(h)i	ARM	M
0	0.40	118.000	0.00	0.000		
25.4560377	0.40	118.000	0.00	0.000		
25.4560377	0.40	118.000	1.19	14.469		
SUM =				**14.47**	**12.73**	**184.16**

h =	21.96					
hi	Kai	Gamma	Fi	Pae(h)i	ARM	M
0	0.40	118.000	0.00	0.000		
21.9560377	0.40	118.000	0.00	0.000		
21.9560377	0.40	118.000	1.03	10.764		
SUM =				**10.76**	**10.98**	**118.16**

h =	13.70					
hi	Kai	Gamma	Fi	Pae(h)i	ARM	M
0	0.40	118.000	0.00	0.000		
13.6994756	0.40	118.000	0.00	0.000		
13.6994756	0.40	118.000	0.64	4.190		
SUM =				**4.19**	**6.85**	**28.70**

h =	5.44					
hi	Kai	Gamma	Fi	Pae(h)i	ARM	M
0	0.40	118.000	0.00	0.000		
5.44291356	0.40	118.000	0.00	0.000		
5.44291356	0.40	118.000	0.25	0.661		
SUM =				**0.66**	**2.72**	**1.80**

Cantilever Abutment Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav/apl
Description:	USAID - Khost Bridge Type Study	**Checked By:**	jz
Structure:	Abutment Design	**Date:**	September 28, 2011

Compute the Lateral Loads on the Stem at Various Heights (cont.)

h =	25.46	W =	9.84				
GROUP:	I	II	III	IV	V	VI	VII
DL =	14.49	14.49	14.49	14.49	13.94	13.94	14.49
arm =	3.20	3.20	3.20	3.20	3.20	3.20	3.20
MDL =	46.40	46.40	46.40	46.40	44.61	44.61	46.40
LL =	16.49		9.87	9.87		9.49	
arm =	3.20		3.20	3.20		3.20	
MLL =	52.79		31.61	31.61		30.40	
Pa(h) =	20.70	20.70	20.70	20.70	20.70	19.90	
arm =	8.49	8.49	8.49	8.49	8.49	8.49	
MPa(h) =	175.63	175.63	175.63	175.63	175.63	168.87	
B =	7.43	7.43	7.43	7.43	7.15	7.15	7.43
arm =	5.53	5.53	5.53	5.53	5.53	5.53	5.53
MB =	41.11	41.11	41.11	41.11	39.53	39.53	41.11
W =		0.00	0.00		0.00	0.00	
arm =		31.46	31.46		31.46	31.46	
MW =		0.00	0.00		0.00	0.00	
WL =			0.10			0.10	
arm =			31.46			31.46	
MWL =			3.23			3.10	
LF =			0.27			0.26	
arm =			31.46			31.46	
MLF =			8.46			8.14	
T =				0.40	0.39	0.39	
arm =				20.37	20.37	20.37	
MT =				8.18	7.87	7.87	
Pae(h) =							18.81
arm =							12.73
MPae(h) =							239.41
Fwi =							8.11
arm =							12.73
MFwi =							103.25
EQ =							7.39
arm =							23.51
MEQ =							173.81
Mtotal =	**315.93**	**263.14**	**306.44**	**302.93**	**267.64**	**302.52**	**603.97**
Vtotal =	**28.13**	**28.13**	**28.50**	**28.53**	**28.23**	**27.79**	**41.74**

h =	21.96	W =	8.87				
GROUP:	I	II	III	IV	V	VI	VII
DL =	14.49	14.49	14.49	14.49	13.94	13.94	14.49
arm =	2.71	2.71	2.71	2.71	2.71	2.71	2.71
MDL =	39.33	39.33	39.33	39.33	37.82	37.82	39.33
LL =	16.49		9.87	9.87		9.49	
arm =	2.71		2.71	2.71		2.71	
MLL =	44.75		26.80	26.80		25.76	
Pa(h) =	15.40	15.40	15.40	15.40	14.81	14.81	
arm =	7.32	7.32	7.32	7.32	7.32	7.32	
MPa(h) =	112.69	112.69	112.69	112.69	108.36	108.36	
B =	4.63	4.63	4.63	4.63	4.45	4.45	4.63
arm =	4.37	4.37	4.37	4.37	4.37	4.37	4.37
MB =	20.20	20.20	20.20	20.20	19.43	19.43	20.20
W =		0.00	0.00		0.00	0.00	
arm =		27.96	27.96		27.96	27.96	
MW =		0.00	0.00		0.00	0.00	
WL =			0.10			0.10	
arm =			27.96			27.96	
MWL =			2.87			2.76	
LF =			0.27			0.26	
arm =			27.96			27.96	
MLF =			7.52			7.23	
T =				0.40	0.39	0.39	
arm =				16.87	16.87	16.87	
MT =				6.78	6.52	6.52	
Pae(h) =							13.99
arm =							10.98
MPae(h) =							153.61
Fwi =							7.00
arm =							10.98
MFwi =							76.81
EQ =							7.39
arm =							20.01
MEQ =							147.94
Mtotal =	**216.97**	**172.22**	**209.41**	**205.80**	**172.12**	**207.87**	**437.89**
Vtotal =	**20.02**	**20.02**	**20.40**	**20.43**	**19.64**	**20.00**	**33.01**

Cantilever Abutment Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav/apl
Description:	USAID - Khost Bridge Type Study	**Checked By:**	jz
Structure:	Abutment Design	**Date:**	September 28, 2011

Compute the Lateral Loads on the Stem at Various Heights (cont.)

h =	13.70	W =	6.57				
GROUP:	I	II	III	IV	V	VI	VII
DL =	14.49	14.49	14.49	14.49	13.94	13.94	14.49
arm =	1.56	1.56	1.56	1.56	1.56	1.56	1.56
MDL =	22.65	22.65	22.65	22.65	21.78	21.78	22.65
LL =	16.49		9.87	9.87		9.49	
arm =	1.56		1.56	1.56		1.56	
MLL =	25.78		15.43	15.43		14.84	
Pa(h) =	5.99	5.99	5.99	5.99	5.76	5.76	
arm =	4.57	4.57	4.57	4.57	4.57	4.57	
MPa(h) =	27.37	27.37	27.37	27.37	26.32	26.32	
B =	0.63	0.63	0.63	0.63	0.61	0.61	0.63
arm =	1.61	1.61	1.61	1.61	1.61	1.61	1.61
MB =	1.02	1.02	1.02	1.02	0.98	0.98	1.02
W =		0.00	0.00		0.00	0.00	
arm =		19.70	19.70		19.70	19.70	
MW =		0.00	0.00		0.00	0.00	
WL =			0.10			0.10	
arm =			19.70			19.70	
MWL =			2.02			1.94	
LF =			0.27			0.26	
arm =			19.70			19.70	
MLF =			5.30			5.10	
T =				0.40	0.39	0.39	
arm =				8.62	8.62	8.62	
MT =				3.46	3.33	3.33	
Pae(h) =							5.45
arm =							6.85
MPae(h) =							37.31
Fwi =							4.37
arm =							6.85
MFwi =							29.90
EQ =							7.39
arm =							11.76
MEQ =							86.90
Mtotal =	**76.82**	**51.05**	**73.80**	**69.94**	**52.41**	**74.29**	**177.80**
Vtotal =	**6.63**	**6.63**	**7.00**	**7.03**	**6.76**	**7.12**	**17.84**

h =	5.44	W =	0.98				
GROUP:	I	II	III	IV	V	VI	VII
DL =							
arm =							
MDL =							
LL =							
arm =							
MLL =							
Pa(h) =	0.95	0.95	0.95	0.95	0.91	0.91	
arm =	1.81	1.81	1.81	1.81	1.81	1.81	
MPa(h) =	1.72	1.72	1.72	1.72	1.65	1.65	
B =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
arm =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MB =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
W =							
arm =							
MW =							
WL =							
arm =							
MWL =							
LF =							
arm =							
MLF =							
T =							
arm =							
MT =							
Pae(h) =							0.86
arm =							2.72
MPae(h) =							2.34
Fwi =							1.73
arm =							2.72
MFwi =							4.72
EQ =							
arm =							
MEQ =							
Mtotal =	**1.72**	**1.72**	**1.72**	**1.72**	**1.65**	**1.65**	**7.06**
Vtotal =	**0.95**	**0.95**	**0.95**	**0.95**	**0.91**	**0.91**	**2.59**

Cantilever Abutment Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav/apl
Description:	USAID - Khost Bridge Type Study	**Checked By:**	jz
Structure:	Abutment Design	**Date:**	September 28, 2011

Stem Reinforcement (REF: AASHTO: 8.16.1.2, 8.16.3.2, 8.17.1)

	SECT 1	SECT 2	SECT 3	SECT 4	
SECTION HEIGHT =	25.46	21.96	13.70	5.44	ft
MOMENT =	603.97	437.89	177.80	7.06	k*ft
ASSUME COVER =	2.00	2.00	2.00	2.00	in
H OF STEM:	9.84	8.87	6.57	0.98	ft
phi =	0.90	0.90	0.90	0.90	
f'c =	4.00	4.00	4.00	4.00	ksi
fy =	60.00	60.00	60.00	60.00	ksi
stirup size # =	0.00	0.00	0.00	0.00	
BAR # =	8.00	8.00	8.00	5.00	
SPACING =	6.00	6.00	12.00	12.00	in
Stirup Abar =	0.00	0.00	0.00	0.00	in^2
Main Abar =	0.79	0.79	0.79	0.31	in^2
Stirup db =	0.00	0.00	0.00	0.00	in
Main db =	1.00	1.00	1.00	0.63	in
As provd. =	1.58	1.58	0.79	0.31	in^2
d =	115.61	103.91	76.29	9.50	in
4/3*As(req.) =	1.56	1.26	0.69	0.22	in^2
As provided =	1.58	1.58	0.79	0.31	in^2
Flexure OK?	OK	OK	OK	OK	
a = Asfy/0.85f'cb =	2.32	2.32	1.16	0.46	in
phi*Mn =phi[Asfy(d-a/2)]/12 kip ft.	813.73	730.51	269.16	12.93	kip*ft
1.2*Mcr=	1267.98	1024.23	552.20	8.56	
Vu =	41.74	33.01	17.84	2.59	kips
bw (per linear ft of wall) =	12.00	12.00	12.00	12.00	in
phi =	0.85	0.85	0.85	0.85	
phiVc = phi*2*f'c^.5*bw*d	149.16	134.06	98.43	12.26	kips
Shear OK?	OK	OK	OK	OK	

BACKWALL & CHEEKWALL DESIGN

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BACKWALL & CHEEK WALL DESIGN (1 BAY)

NOTE: RESULTS FROM CONSPAN ARE PER BEARING. DESIGN IS BASED ON FULL SEISMIC AT ONE END OF SPAN. DOUBLE REACTIONS FROM CONSPAN.

SEISMIC FORCE ON BACKWALL & CHEEK WALL

DEAD LOAD OF SUPERSTRUCTURE = (29.8 + 14.7 + 17 + 8) * 5 BEAMS * 2 = 695^K (SEE CONSPAN RESULTS)
(FULL SPAN LENGTH)

ACCELERATION COEFFICIENT = 0.17

SITE COEFFICIENT = 1.5 (SOIL PROFILE TYPE III) (TABLE 3.5.1 AASHTO)

SEISMIC FORCE ON BACK WALL = (0.17)(1.5)(695) = 177.2^K

SEISMIC FORCE ON CHEEK WALL = 177.2^K / 2 = 88.6^K

CHECK SHEAR FRICTION ON BACKWALL & CHEEKWALL
(REF. AASHTO'S SECTION 8.16.6.4.4)

$V_n = A_{vf} * f_y * \mu$ (EQ 8-56, AASHTO)

** NOTE: LOOKING AT BACKWALL & CHEEKWALLS PER FOOT OF WALL.

BACKWALL

LENGTH = 8.6m (28.2')

SEISMIC PER FOOT = 6.28 K PER LF

* TRY #5 @ 12" o.c.

A_{vf} = (1) × (2 legs) × (0.31) = 0.62 in^2
f_y = 60 ksi
μ = 1.0 × λ = (1.0)(1.0) = 1

V_n = (0.62)(60)(1) = 37.2^K

CHEEKWALL

LENGTH = 1.3m (4.27')

SEISMIC PER FOOT = 20.75 K PER LF

* TRY #5 @ 10" o.c.

A_{vf} = (1) × (2 legs) × (0.31 * 12/10) = 0.744 in^2
f_y = 60 ksi
μ = 1.0 × λ = (1.0)(1.0) = 1

V_n = (0.744)(60)(1) = 44.64^K

TETRA TECH
One Grant Street
Framingham, MA 01701-9005
(508) 903-2000

JOB KHOST BRIDGE
SHEET NO. BACKWALL & CHEEKWALL OF
CALCULATED BY nav DATE 9/21/11
CHECKED BY JE DATE 9/22/11
SCALE

BACKWALL & CHEEKWALL DESIGN (CONT.)

CHECK REQUIREMENT OF SECTION 8.16.6.4.5

BACKWALL

WIDTH OF BACKWALL = 0.3m [11.81"]

$A_{cv} = (11.81)(12) = 141.7\ in^2$
$f'_c = 4000$ psi

$V_n = 0.2 f'_c A_{cv}$
$= (0.2)(4000)(141.7) = 113{,}386$ LB

$= 113.4^k > 37.2^k$ OK

∴ CONTROLLING $V_n = 37.2^k$

CHEEKWALL

WIDTH OF CHEEKWALL = 0.45m [17.72"]

$A_{cv} = (17.72)(12) = 212.64\ in^2$
$f'_c = 4000$ psi

$V_n = 0.2 f'_c A_{cv}$
$= (0.2)(4000)(212.64) = 170{,}112$ lb

$= 170.1^k > 44.64^k$ OK

∴ CONTROLLING $V_n = 44.64^k$

CHECK EQUATION 8-46 (AASHTO)

BACKWALL

$\phi = 0.85$
$\phi V_n = (0.85)(37.2) = 31.62$ k/LF

$V_u = 6.28^k < \phi V_n$ OK

#5 @ 12" o.c. [16 @ 300]

CHEEKWALL

$\phi = 0.85$
$\phi V_n = (0.85)(44.64) = 37.94$ k/LF

$V_u = 20.75^k < \phi V_n$ OK

#5 @ 10" o.c. [16 Φ @ 250]

CHECK DEVELOPMENT LENGTH (ACI SECTION 12.2.2)

$$l_d = \left(\frac{f_y\ \psi_t\ \psi_e}{25 \times \sqrt{f'_c}}\right) d_b = \left(\frac{(60000)(1)(1.2)}{(25)(1.0)(\sqrt{4000})}\right) 0.625'' = 28.5'' = 723\text{ mm}$$

$f_y = 60$ ksi
$\psi_t = 1.0$
$\psi_e = 1.2$
$\lambda = 1.0$ (normal concrete)
$f'_c = 4{,}000$ psi
$d_b = 0.625$ in

USE DEVELOPMENT LENGTH OF 750 mm TYPICAL AT BACKWALL & CHEEKWALL

TETRA TECH
One Grant Street
Framingham, MA 01701-9005
(508) 903-2000

JOB Knost BRIDGE
SHEET NO. BACKWALL & CHEEKWALL OF
CALCULATED BY nav DATE 9/21/11
CHECKED BY JZ DATE 9/22/11
SCALE

PIER

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PIER LOADING CALCULATIONS

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PIER LOADING CALCULATIONS

GENERAL INFORMATION

Project Number:	127-1298-10001-LT0009	Designed By:	nav
Description:	USAID - Khost Bridge	Checked By:	jz
Structure:	Intermediate Pier Loading (Transverse & Longitudinal Directions)	Date:	9/27/2011

References: AASHTO Standard Specification for Highways and Bridges, 17th Edition, 2002

Notes: This spreadsheet computes the loads on a pier, considering the spans left and right of the pier are simply supported.

PIER LOADING CALCULATIONS

GENERAL INFORMATION

Project Number:	127-1298-10001-LT0009	Designed By:	nav
Description:	USAID - Khost Bridge	Checked By:	jz
Structure:	Intermediate Pier Loading (Transverse & Longitudinal Directions)	Date:	9/27/2011

PIER GEOMETRY

Total Length of Bridge =	195	m	639.76	ft
Number of Spans =	13			
Span Length =	15.00	m	49.21	ft
Top of Roadway Elevation =	1188.890	m	3900.56	ft
Top of Bridge Seat/Pier Elevation =	1187.231	m	3895.11	ft
Top of Footing Elevation =	1182.581	m	3879.86	ft
Bottom of Footing Elevation =	1181.831	m	3877.40	ft
Elevation of High Water =	1186.190	m	3891.70	ft
Assumed Bearing Height =	0.110	m	0.36	ft
Distance from T.O. Roadway to Bridge Seat =	1.66	m	5.44	ft
Number of Lanes =	2			

Pier Thickness =	1.50	m	4.92	ft
Pier Width =	11.00	m	36.09	ft
Pier Height =	5.40	m	17.72	ft
Stem Height =	4.65	m	15.26	ft
Height of Soil Above Footing =	1.92	m	6.30	ft
Footing Height =	0.75	m	2.46	ft
Footing Width =	12.00	m	39.37	ft
Footing Length =	3.90	m	12.80	ft

SUPERSTRUCTURE GEOMETRY

Deck:

Superstructure Width =	9.5	m	31.17	ft
Roadway Cross-Slope =	2	%		
Structural Slab Thickness =	225	mm	8.86	in
Max Structural Slab Thickness =	406.0	mm	15.98	in

Total Deck Area = 30.22 ft^2 / LF

Sidewalk:

# of Sidewalks =	1			
Sidewalk Width =	1.2	m	3.94	ft
Average Sidewalk Thickness =	0.2	m	0.66	ft

Total Sidewalk Area = 2.58 ft^2 / LF

Girders:

# of Girders =	5			
Girder Depth =	1.25	m	4.10	ft
Girder Width =	0.55	m	1.80	ft

Total Girder Area = 37.00 ft^2 / LF

Barrier:

# of Barriers =	2			
Barrier Height =	1.05	m	3.44	ft
Barrier Width =	0.45	m	1.48	ft

Total Barrier Area = 10.17 ft^2 / LF

PIER LOADING CALCULATIONS

GENERAL INFORMATION

Project Number:	127-1298-10001-LT0009	Designed By:	nav
Description:	USAID - Khost Bridge	Checked By:	jz
Structure:	Intermediate Pier Loading (Transverse & Longitudinal Directions)	Date:	9/27/2011

SUPERSTRUCTURE LOADING ON PIER - VERTICAL FORCES

Dead Load, DL

				Unit Weight			
Total Deck Area =	30.22	ft^2 / LF	x	150	pcf	4.53	kips / ft / LF
Total Girder Area =	37.00	ft^2 / LF	x	150	pcf	5.55	kips / ft / LF
Total Side Walk Area =	2.58	ft^2 / LF	x	150	pcf	0.39	kips / ft / LF
# of Barriers =	10.17	ft^2 / LF	x	150	pcf	1.53	kips / ft / LF

	Left Span	Right Span	
L =	49.21	49.21	ft
Total Superstructure Weight =	12.00	12.00	kips / ft / LF
Reaction, Dead Load =	295.17	295.17	kips
Conspan Total Dead Load =	347.5	347.5	kips

<—DL from Conspan includes additional superstructure loads not included in section above

Total Reaction, Dead Load = 695.00 kips

Load Application = 2.5 *ft (Long)*, 18.0 *ft (Trans)* } Applied at Midpoint

Live Load, LL

Truck Loading:

	Left Span	Right Span		
L =	49.21	49.21	ft	
Impact (I) =	1.29	1.29	= 1 + 50/(L + 125) ≤ 1.3	Section 3.8.2.1
Number of Lanes =	2	2		
Reduction in Load Intensity =	1.00	1.00		Section 3.12.1
AASHTO Vmax =	58.3	58.3	kips	App. A, "LOADING - HS 20-44 (MS18)"
Vmax =	116.6	116.6		
H25 Multiplier =	1.25	1.25		
Reaction, LL V =	145.8	145.8	kips	
Reaction, (LL+I) V =	188.1	188.1	kips	

Total Reaction, Truck (LL) = 292 kips *<== Greater Than Lane Load (LL), Controls*

Total Reaction, Truck (LL+I) = 376 kips *<== Greater Than Lane Load (LL), Controls*

PIER LOADING CALCULATIONS

GENERAL INFORMATION

Project Number:	127-1298-10001-LT0009	Designed By:	nav
Description:	USAID - Khost Bridge	Checked By:	jz
Structure:	Intermediate Pier Loading (Transverse & Longitudinal Directions)	Date:	9/27/2011

SUPERSTRUCTURE LOADING ON PIER - VERTICAL FORCES (CONT.)

Live Load, LL (cont.)

Lane Loading:

Number of Lanes =	2			
Reduction in Load Intensity =	1			Section 3.12.1
HS-20 Lane Load =	640	plf		Figure 3.7.6B
HS-25 Lane Load =	1600	plf	<------- Increase HS-20 by : 25%	

	Left Span	Right Span	
Reaction, Lane Load (LL) =	39.4	39.4	kips
Reaction, Lane Load (LL+I) =	50.8	50.8	kips

Number of Lanes =	2			
Reduction in Load Intensity =	1			
HS-20 Concentrated (LL) =	26	kips	<------- Concentrate load for shear	Figure 3.7.6B
HS-25 Concentrated (LL) =	65	kips	<------- Increase HS-20 by : 25%	

HS-25 Concentrated (LL+I) = 83.9 kips (using Max Impact from Both Spans)

Total Reaction, Lane Load (LL) = 209 kips *<== Less Than Truck (LL), Does Not Control*

Total Reaction, Lane Load (LL+I) = 269 kips *<== Less Than Truck (LL+I), Does Not Control*

Controlling Live Load, LL & LL+I

Total (LL) = 292 *kips on Pier* <-- Run 1: Bearing Pressure & Footing Design

Total (LL+I) = 376 *kips on Pier* <-- Run 2: Pier Stem Design

Load Application = 2.5 *ft (Long)*, 18.0 *ft (Trans)* } Applied at Midpoint

PIER LOADING CALCULATIONS

GENERAL INFORMATION

Project Number:	127-1298-10001-LT0009	Designed By:	nav
Description:	USAID - Khost Bridge	Checked By:	jz
Structure:	Intermediate Pier Loading (Transverse & Longitudinal Directions)	Date:	9/27/2011

SUPERSTRUCTURE LOADING ON PIER - VERTICAL FORCES (CONT.)

Uplift on Deck, W_U

Structure Area = 31.17 SF/LF

Uplift Pressure (W_U) = 20 psf — Section 3.15.3

	Left Span	Right Span	
L =	49.2	49.2	ft
Reaction,Uplift (W_U) =	15.3	15.3	kips

Total Reaction, Uplift (W_U) = 30.6 kips

Load Application = 7.79 *ft from Center Line of Pier*
25.83 *ft from Opposite Face of Pier*
} *Apply at windward 1/4 point*

SUPERSTRUCTURE LOADING ON PIER - LATERAL FORCES

Longitudinal Live Load Calculation, LF — Section 3.9

Number of Lanes = 2
Reduction in Load Intensity = 1
HS-20 Concentrated (LL) = 18 kips <------- Concentrate load for moment — Figure 3.7.6B
HS-25 Concentrated (LL) = 45 kips <------- Increase HS-20 by : 25%

Lane Load on Pier plus Concentrated Load = 169 kips

Long. Load on Pier (LF) = 8.45 kips <---- (5% * (Total Lane Load + Concentrated Load))

Load Application = 6.00 *ft Above Roadway Deck* = 11.44 ft above bearing seat

PIER LOADING CALCULATIONS

GENERAL INFORMATION

Project Number:	127-1298-10001-LT0009	Designed By:	nav
Description:	USAID - Khost Bridge	Checked By:	jz
Structure:	Intermediate Pier Loading (Transverse & Longitudinal Directions)	Date:	9/27/2011

SUPERSTRUCTURE LOADING ON PIER - LATERAL FORCES (CONT.)

Wind Load on Live Load, WL

WL = 100 plf (Conservative to Apply in Both Directions) — Section 3.15.2.1

	Left Span	Right Span	
Reaction, WL per span =	2.46	2.46	kips

Total Reaction, Wind Load on LL (WL)= 4.92 kips

Load Application = 6.00 *ft Above Roadway Deck* = 11.44 ft above bearing seat

Wind Area, W_T (Transverse)

Wind Area Distributed = 9.53 ft^2/LF <------- Barrier Height + Slab Thickness (max) + Average Sidewalk Thickness + Girder Depth

Wind Pressure = 50 psf — Section 3.15.2.1

W windward = 477 plf > 300, USE: 477 plf — Section 3.15.1.1.2

	Left Span	Right Span	
Reaction, W_T per span =	11.74	11.74	kips

Total Reaction, Wind Area, Trans(W_T) = 23.47 *kips*

Load Application = 5.13 *ft Above Bridge Seat*

PIER LOADING CALCULATIONS

GENERAL INFORMATION

Project Number:	127-1298-10001-LT0009	Designed By:	nav
Description:	USAID - Khost Bridge	Checked By:	jz
Structure:	Intermediate Pier Loading (Transverse & Longitudinal Directions)	Date:	9/27/2011

SUPERSTRUCTURE LOADING ON PIER - LATERAL FORCES (CONT.)

Wind Area, W_T (Longitudinal)

A longitudinal = 9.53 ft^2 x 12 psf

Total Reaction, Wind Area, Long (W_T) = 0.1 *kip*

Load Application = 5.13 *ft Above Bridge Seat*

Wind Load on Pier, W_S (Transverse)

Apier(x) = 44.08 ft^2

Wind Pressure on Pier = 40 psf — Section 3.15.2.2

Total Reaction, Wind Load on Pier, Trans. (W_S) = 1.8 *kips*

Load Application = 4.48 *ft - Applied halfway up the exposed stem*

Wind Load on Pier, W_S (Longitudinal)

Apier(y) = 301.97 ft^2 ***(60 degree)***

Wind Pressure on Pier = 40 psf — Section 3.15.2.2

Total Reaction, Wind Load on Pier, Long. (W_{SL}) = 10.5 *kips*

Total Reaction, Wind Load on Pier, Long. (W_{ST}) = 6 *kips*

Load Application = 4.48 *ft - Applied halfway up the exposed stem*

PIER LOADING CALCULATIONS

GENERAL INFORMATION

Project Number:	127-1298-10001-LT0009	Designed By:	nav
Description:	USAID - Khost Bridge	Checked By:	jz
Structure:	Intermediate Pier Loading (Transverse & Longitudinal Directions)	Date:	9/27/2011

SUPERSTRUCTURE LOADING ON PIER - LATERAL FORCES (CONT.)

Stream Pressure, Pmax — Section 3.18.1

Vavg = 3.37 m/s (Per Hydrologic Report)
Vavg = 11.06 ft/s
K = 0.8 — Section 3.18.1.1.1
Pavg = 97.80 psf

Stream Pressure (Pmax) = 195.60 *psf*

Assume : Pmax located at max water elevation (Conservative)
Flow line is at bottom of ftg (Conservative)

Load Application = 9.53 *ft - Apply at 2/3 point from bottom of Footing*

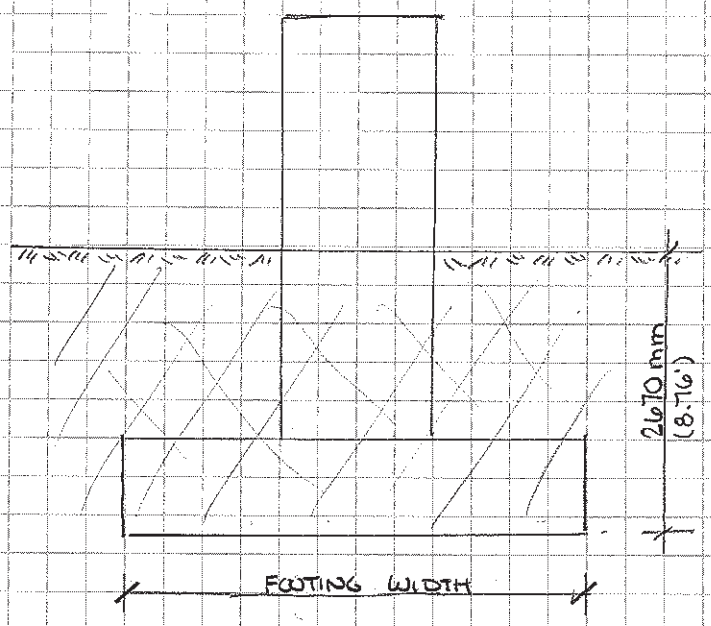
SUMMARY OF SUPERSTRUCTURE LOADS ON PIER

LOAD		Transverse		Longitudinal		Note: Load Application	
		Load (kips)	Arm from Face of Pier Stem(ft):	Load (Kips)	Arm from Face of Pier Stem(ft):		
Superstucture Dead Load	DL	695.00	18.04	695.00	2.46	Apply at midpoint of Stem	
Live Load (No Impact)	LL	291.60	18.04	291.60	2.46	Apply at midpoint of Stem	
Live Load (w/ Impact)	LL + I	376.20	18.04	376.20	2.46	Apply at midpoint of Stem	
Live Load (No Impact) - MLC 70	LL	473.50	18.04	473.50	2.46	Apply at midpoint of Stem	<--- ConSpan
Uplift	W_U	30.60	25.83	0.00	-	Apply at windward 1/4 point of Stem	
Wind on Structure (Pier)	W_S	1.80	4.48	10.50	4.48	Apply halfway up exposed Stem	
Wind on Superstructure	W_T	23.47	5.13	0.10	5.13	Apply above Bridge Seat	
Wind Load on Live Load	WL	4.92	11.44	4.92	11.44	Apply above Bridge Seat	
Longitudinal & Friction	LF	0.00	-	8.45	11.44	Apply above Bridge Seat	
Thermal Force	T	0.00	-	0.00	-		
Seismic Force	EQ	177.23	3.50	177.23	3.50	Apply at the centriod of Superstructure	<---See Hand Calc

LOAD		Transverse		Longitudinal		Note: Load Application
		Load (psf)	Arm (ft)	Load (psf)	Arm (ft)	
Stream Pressure	Pmax	196	9.53	0	-	Apply at 2/3 point from bottom of Footing

ALLOWABLE BEARING PRESSURE - PIER

NET ALLOWABLE = 4000 PSF (PER GEOTECHNICAL CALCULATIONS)



ALLOWABLE INCREASES TO BEARING PRESSURE:

BURIED PORTION OF SUBSTRUCTURE = (8.76)(118) = 1034

40% INCREASE @ TOE = (4000)(1.4) = 5600

6634 PSF

ALLOWABLE BEARING

TETRA TECH

One Grant Street
Framingham, MA 01701-9005
(508) 903-2000

JOB KHOST BRIDGE
SHEET NO. B.P. ABUTMENT OF
CALCULATED BY NAV DATE 9/22/11
CHECKED BY JZ DATE 9/27/11
SCALE

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PIER TRANSVERSE DESIGN

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Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Transverse Section	**Date:**	September 28, 2011

References:

AASHTO Standard Specification for Highways and Bridges, 17th Edition, 2002
ACI 318-05 Building Code Requirements for Structural Concrete, 2005
MassHighway Bridge Manual, 2005

Notes:

General Design Parameters

TRANSVERSE SECTION CUT

GEOMETRY INFORMATION INPUT:

PROPOSED TOP OF ROADWAY ELEV:	3900.56	ft	1188.890	m
PROPOSED TOP OF PIER ELEV:	3895.11	ft	1187.231	m
PROPOSED TOP OF FOOTING ELEV:	3879.86	ft	1182.581	m
PROPOSED BOT. OF FOOTING ELEV:	3877.40	ft	1181.831	m
ELEVATION OF HIGH WATER:	3891.70	ft	1186.190	m
PROPOSED PIER WIDTH (AT TOP):	36.09	ft	11.000	m
PROPOSED PIER WIDTH (AT BOTTOM):	36.09	ft	11.000	m
PROPOSED FOOTING WIDTH:	39.37	ft	12.000	m
PROPOSED PIER THICKNESS:	4.92	ft	1.50	m
PROPOSED FOOTING LENGTH:	12.80	ft	3.90	m

MATERIAL PROPERTIES:

CUBIC WEIGHT CONCRETE:	150.00	lbs/CF
COMP. STRENGTH OF CONC. = F'c:	4.00	ksi
TENSILE STRENGTH OF REBAR = Fy:	60.00	ksi

GEOTECHNICAL INFORMATION:

WEIGHT OF SOIL BACKFILL (STRATA 1):	118.00	Lbs/CF		
WEIGHT OF SOIL BACKFILL (STRATA 2):	118.00	Lbs/CF		
ALLOWABLE BEARING CAPACITY:	6.63	ksf		
WALL ON LEDGE:	N	(Y OR N)		
WALL ON PILES:	N	(Y OR N)		
BETA: SLOPE OF BACKFILL:	0.00	DEG	RAD =	0.0000
PHI: FRICTION ANGLE FOR SLIDING:	26.56	DEG	RAD =	0.4636
DELTA 1: ANGLE BACKWALL FRICTION:	17.00	DEG	RAD =	0.2967
DELTA 2: ANGLE BACKWALL FRICTION:	17.00	DEG	RAD =	0.2967
THETA: BATTER ANGLE BACKWALL:	90.00	DEG	RAD =	1.5708
PHI 1: FRICTION ANGLE OF BACKFILL:	27.00	DEG	RAD =	0.4712
PHI 2: FRICTION ANGLE OF BACKFILL:	27.00	DEG	RAD =	0.4712
COEFFICIENT OF ACTIVE PRESSURE, Ka:	0.33			

STREAM PRESSURE

Pmax:	196.00	psf
CONSIDER STREAM FLOW:	Y	

APPLIED ONLY IN THE TRANSVERSE DIRECTION

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Transverse Section	**Date:**	September 28, 2011

General Loading Parameters

LIVE LOAD INFORMATION:

APPROACH SLAB:	N	(Y OR N)
ROADWAY WITHIN H/2 OF TOP OF WALL:	N	(Y OR N)
CONSIDER LL SURCHARGE ?	N	(Y OR N)
SURCHARGE HEIGHT:	0.00	ft
CONSTRUCTION SURCHARGE:	0.00	psf

SEISMIC LOAD INFORMATION:

WALL RESTRAINED HORZ. MOVMT.(Y/N):	N	(Y OR N)	<----Superstructure has been designed to accommodate the movement required.
SEISMIC ACCELERATION COEFF. A:	0.17	REF: FIG. 3.2A Div IA, AASHTO	
SEISMIC CATEGORY:	B	REF: Table 3.4 Div IA, AASHTO	

ADDITIONAL LOADS ON STRUCTURE (load is per linear foot of structure, arm from front edge of pier)

		Beam 1 Rxn (kips)	Beam 2 Rxn (kips)	Beam 3 Rxn (kips)	Beam 4 Rxn (kips)	Beam 5 Rxn (kips)	Total Super Rxn (kips)	LOAD (klf)	ARM (feet)	
SUPERSTRUCT. DEAD LOAD:	DL						695.00	141.22	18.04	
LIVE LOAD (NO IMPACT):	LL						473.50	96.22	18.04	
UPLIFT :	W_U						-30.60	-6.22	25.83	
WIND ON STRUCTURE: (PIER)	W_S						6.00	1.22	-4.48	<---Apply halfway up exposed stem
WIND AREA:	W_T						23.47	4.77	5.13	
WIND LOAD ON LIVE LOAD:	WL						4.92	1.00	11.44	
LONGITUDINAL & FRICTION:	LF						0.00	0.00	11.44	
THERMAL FORCE:	T						0.00	0.00	0.00	
SEISMIC LOAD ON SUPERSTRUCT:	EQ						177.23	13.85	3.50	<--- Apply at the centroid of superstructure

Note: Load (kips per linear foot of pier)

Intermediate Pier Design

General Information

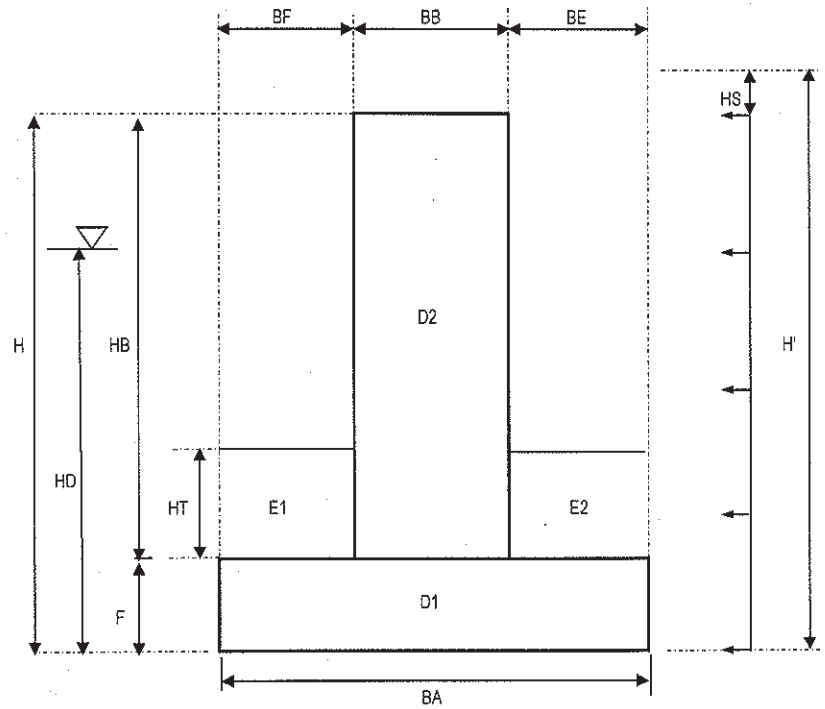
Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Transverse Section	**Date:**	September 28, 2011

Pier Geometry

TRANSVERSE SECTION CUT

CALCULATION OF WALL AND BACKFILL GEOMETRY:

	Prelim Size	User Adjust	Final Size	Final Size (m)
HEIGHT OF PIER, H:	17.717	0.00	17.72	5.40
HEIGHT OF FOOTING, F:	2.000	0.46	2.46	0.75
HEIGHT OF STEM, HB:	15.256	0.00	15.26	4.65
HEIGHT OF HIGH WATER, HD:	14.301	0.00	14.30	4.36
HEIGHT OF SURCHARGE, HS:	0.000	0.00	0.00	0.00
THEORETICAL HEIGHT W/ SURCHARGE, H':	17.717	0.00	17.72	5.40
WIDTH OF FOOTING, BA:	10.000	29.37	39.37	12.00
WIDTH OF WALL AT TOP, BB:	36.089	0.00	36.09	11.00
WIDTH OF FOOTING HEEL, BE	1.640	0.00	1.64	0.50
WIDTH OF FOOTING TOE, BF:	1.640	0.00	1.64	0.50
HEIGHT OF SOIL OVER TOE, HT:	6.299	0.00	6.30	1.92
HEIGHT OF SOIL	8.760	0.00	8.76	2.67
LENGTH OF FOOTING:	12.795	0.00	12.80	3.90



Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Transverse Section	**Date:**	September 28, 2011

Results Summary:

STABILITY RESULTS:

GROUP:	I	II	III	IV	V	VI	VII	I-CON
OVERTURNING:	275.63	31.95	74.33	275.63	31.95	74.33	4.42	531.48
F.S.allowable = 2.00	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
SLIDING:	32.58	10.85	21.27	32.58	10.85	21.27	1.69	39.41
F.S.allowable = 1.50	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
Max BP (with Bouy):	3.44	2.70	3.54	3.44	2.70	3.54	4.14	3.05
Max BP (w/o Bouy):	4.01	3.27	4.12	4.01	3.27	4.12	4.71	3.05
ALLOWABLE:	6.63	8.29	8.29	8.29	9.29	9.29	8.84	6.63
Bear. Check:	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
Kern Check:	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.

REINFORCEMENT RESULTS:

= As Provided / As Required

	STIRUP #	BAR #	SPAC.	REINF. RATIO	FLEX OK?	LBS./ L.F.	LENGTH OF BAR	No. Bars per ft	Wt. of bar PER L.F.	As/LF	SHEAR OK?
TOE(bot):	0.00	6.00	12.00	3.30	OK	58.20	38.87	1.00	1.50	0.44	OK
HEEL(top):	0.00	6.00	12.00	3.30	OK	58.20	38.87	1.00	1.50	0.44	OK
STEM 1 (at top of ftg):	0.00	6.00	7.00	2.36	OK	23.00	8.96	1.71	1.50	0.44	OK
STEM 2 (at top of ftg dwl):	0.00	6.00	12.00	2.29	OK	22.34	14.92	1.00	1.50	0.44	OK
STEM 3 (midpt back face):	0.00	6.00	12.00	3.96	OK	0.00	0.00	1.00	1.50	0.44	OK
TOTAL WT. STEEL/FT OF ABUT.=						161.74	LBS./LF				

Intermediate Pier Design

General Information

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Structure:	Intermediate Pier - Transverse Section	**Date:**	September 28, 2011

Calculate Earth Pressure

These lateral earth pressure calculations include the effects of additional lateral earth pressure due to live load surcharge, if applicable.

Per AASHTO 3.20.3, when highway traffic can come within a horizontal distance from the top of the structure equal to 1/2 its height, the pressure shall have added to it a live load surcharge pressure qual to not less than 2 feet of earth. This surcharge is to be treated an an additional earth pressure.

Coulomb's Active Earth Pressure: (Figure 5.5.2A)

	STRATA 1			STRATA 2	
GAMMA =	118.00	pcf	GAMMA =	118.00	pcf
Height of Earth =	8.76	Feet	Height of Earth =	8.76	Feet
THETA =	90.00	Degrees	THETA =	90.00	Degrees
BETA =	0.00	Degrees	BETA =	0.00	Degrees
PHI =	27.00	Degrees	PHI =	27.00	Degrees
DELTA =	17.00	Degrees	DELTA =	17.00	Degrees
Ka (1) =	**0.335**		**Ka (2) =**	**0.335**	

At-Rest Earth Pressure Coeff:

	STRATA 1		STRATA 2
Ko (1) =	**0.546**	**Ko (2) =**	**0.546**

Earth Pressure Coefficient to be Used for Design:

Design of walls on rock or piles shall use Ko. Cantilever walls shall use Ka. Active pressure coefficients shall be estimated using Coulomb Theory.

WALL ON LEDGE:	N	(Y OR N)
WALL ON PILES:	N	(Y OR N)
Wall Height:	17.7165354	ft
Earth pressure Type:	Ka	

	STRATA 1		STRATA 2
Ke (1) =	**0.335**	**Ke (2) =**	**0.335**

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Transverse Section	**Date:**	September 28, 2011

Calculate Earth Pressure Cont.

Pi(h) =1/2(Ke)(Gamma)(hi^2)cos(90-theta+delta)
Pi(v) =1/2(Ke)(Gamma)(hi^2)sin(90-theta+delta)

Note: These equations are shown, but not used in the final loads. Due to the small height of earth, it is assumed the lateral earth pressure will act horizontal.

Compute Earth Loads and Moments:

	hi	Kai	Gamma	Fi	Pi	DELTA	Pi(h)	ARM	Mi	Pi(v)	ARM	Mi
1	0.00	0.335	118.00	0.000	0.00	17.00	0.00	8.76	0.00	0.00	39.37	0.00
2	8.76	0.335	118.00	0.000	0.00	17.00	0.00	4.38	0.00	0.00	39.37	0.00
3	8.76	0.335	118.00	0.346	1.52	17.00	1.45	2.92	4.23	0.44	39.37	17.46
SUM =					**1.52**		**1.52**	**2.92**	**4.43**	**0.00**	**0.00**	**0.00**

Design based on Equivalent Fluid Pressure:

n/a

EFPa, Above Water =	0.00	pcf
EFPb, Below Water =	0.00	pcf
Earth Height =	8.76	ft
H Under Water, HD=	8.76	ft
H Above Water, H1=	0	ft

Pi(h) =1/2(EFP)(hi^2)
Pi(v) =0

Compute Earth Loads and Moments per Geotech Report:

	hi	Kai	Gamma	Fi	Pi	DELTA	Pi(h)	ARM	Mi	Pi(v)	ARM	Mi
1	0.00	0.546	118.00	0.000	0.00		0.00	8.76	0.00			
2	8.76	0.546	118.00	0.000	0.00		0.00	4.38	0.00			
3	8.76	0.546	118.00	0.000	0.00		0.00	2.92	0.00			
SUM =					**0.00**		**0.00**	**2.92**	**0.00**	**0.00**	**0.00**	**0.00**

SUMMARY AND RESULTANT OF EARTH PRESSURES (to be used for design):

	FORCE (Kips)	ARM (Feet)	MOM (Ft x K)
Pa(v) =	0.00	0.00	0.00
Pa(h) =	1.52	2.92	4.43
Pa =	**1.517**		

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
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Structure:	Intermediate Pier - Transverse Section	**Date:**	September 28, 2011

Calculate Seismic Forces

(Ref: AASHTO DIV1A, Section 6.4 and 1998 Commentary C6.4.3 for Mononobe-Okabe Analysis.) - Mononobe

	STRATA 1				STRATA 2			
GAMMA =	118.00	Lbs/CF			118.00	Lbs/CF		
Height of Earth =	8.76	Feet			8.76	Feet		
PHI =	27.00	Degrees =	0.47	Radians	27.00	Degrees =	0.47	Radians
THETA =	4.86	Degrees =	0.08	Radians	4.86	Degrees =	0.08	Radians
DELTA =	17.00	Degrees =	0.30	Radians	17.00	Degrees =	0.30	Radians
A =	0.17				0.17			
kh =	0.085				0.085			
i =	0.00	Degrees =	0.00	Radians	0.00	Degrees =	0.00	Radians
BETA =	0.00	Degrees =	0.00	Radians	0.00	Degrees =	0.00	Radians

SEISMIC ACTIVE EARTH PRESSURE (AASHTO 1998 Commentary, C6.4.3)

Kae (1) = 0.396 **Kae (2) =** 0.396

Pi(h) =1/2(Ke)(Gamma)(hi^2)cos(90-theta+delta)
Pi(v) =1/2(Ke)(Gamma)(hi^2)sin(90-theta+delta)

Note: These equations are shown, but not used in the final loads. Due to the small height of earth, it is assumed the lateral seismic pressure will act horizontal.

Compute Seismic Loads and Moments:

	hi	Kai	Gamma	Fi	Pi	DELTA	Pi(h)	ARM	Mi	Pi(v)	ARM	Mi
1	0.00	0.396	118.00	0.000	0.00	17	0.00			0.00		
2	8.76	0.396	118.00	0.000	0.00	17	0.00			0.00		
3	8.76	0.396	118.00	0.409	1.79	17	1.71			0.52		
SUM =					**1.79**		**1.79**	**4.38**	**7.85**	**0.00**	**0.00**	**0.00**

RESULTANT OF SEISMIC EARTH PRESSURE: (AASHTO 1998 Commentary, C6.4.3)

Pae = GAMMAxKaH^2/2 =

Eae=Pae = 1.792 Kips
ASSUME Pae ACTS AT H/2 = 4.380 ft

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Transverse Section	**Date:**	September 28, 2011

Calculate Seismic Forces Cont.

WALL INERTIA EFFECTS

Per AASHTO DIV 1A 6.4.3, seismic design should take into account forces arising from seismically induced lateral earth pressures (as computed above), additional forces arising from wall inertia and the transfer of seismic forces from the bridge deck through bearing supports which do not slide freely.

The following table computes the inertia forces due to the weight of the concrete and backfill.

kh = **0.085**

	AREA #	DL (Kips)	DL*kh (Kips)	ARM (Feet)	MOM (Ft x K)
DL Wall	D1	14.53	1.24	1.23	1.52
	D2	82.59	7.02	10.09	70.82
	D3	0.00	0.00	17.72	0.00
	D4	0.00	0.00	7.55	0.00
	D5	0.00	0.00	0.00	0.00
	Subtotal	**97.12**	**8.25**	**8.76**	**72.34**
DL Backfill	E1	49.26	4.19	12.63	52.89
	E2	0.00	0.00	17.72	0.00
	E3	0.00	0.00	10.09	0.00
	E4	0.00	0.00	5.61	0.00
	Subtotal	**49.26**	**4.19**	**12.63**	**52.89**
TOTAL		**146.38**	**12.44**	**10.06**	**125.23**

SUMMARY OF SEISMIC LOADS:

	FORCE (Kips)	ARM (Feet)	MOM (Ft x K)
Pae(v) = Pae x SIN(90-TH+DEL) =	0.00	0.00	0.00
Pae(h) = Pae x COS(90-TH+DEL) =	1.79	4.38	7.85
Fwi(h) = kh x Wbackfill =	12.44	10.06	125.23
EQ Superstructure =	13.85	21.22	293.87

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Transverse Section	**Date:**	September 28, 2011

Construction Surcharge <-- N/A

Consider the following surcharge during construction. <--- NOT APPLICABLE - NO SURCHARGE

Pcon(h) = p*H*Length =	0.00	kips
MconOT = Pconh*H/2 =	0.00	kip*ft
Pcon(v) = q*BE*Length =	0.00	kips
MconR = Pconv*(BA-BE/2) =	0.00	kip*ft

Loads from Superstructure

LOADS FOR FACTORED LOAD GROUPS - REINFORCEMENT

LOAD	VERTICAL			HORIZONTAL		
	FORCE (Kips)	ARM (Feet)	MOM (Ft x K)	FORCE (Kips)	ARM (Feet)	MOM (Ft x K)
DL	141.22	19.69	2780.00	-	-	-
LL	96.22	19.69	1894.00	-	-	-
W_S	-	-	-	1.22	13.24	16.14
W_T	-	-	-	4.77	22.85	108.96
W_U	-6.22	27.47	-170.81	-	-	-
W (total)	-6.22	27.47	-170.81	5.99	20.89	125.10
WL	-	-	-	1.00	29.16	29.15
LF	-	-	-	0.00	29.16	0.00
T	-	-	-	0.00	17.72	0.00
EQ	-	-	-	Included in EQ Calcs Above		

Notes: Load distributed along pier width
Wind load on pier conservatively taken at top of pier

LOADS FOR SERVICE LOAD GROUP - STABILITY

LOAD	VERTICAL			HORIZONTAL		
	FORCE (Kips)	ARM (Feet)	MOM (Ft x K)	FORCE (Kips)	ARM (Feet)	MOM (Ft x K)
DL	54.32	19.69	1069.23	0.00	0.00	0.00
LL	37.01	19.69	728.46	0.00	0.00	0.00
W_S	0.00	0.00	0.00	0.47	13.24	6.21
W_T	0.00	0.00	0.00	1.83	22.85	41.91
W_U	-2.39	27.47	-65.70	0.00	0.00	0.00
W (total)	-2.39	27.47	-65.70	2.30	20.89	48.11
WL	0.00	0.00	0.00	0.38	29.16	11.21
LF	0.00	0.00	0.00	0.00	29.16	0.00
T	0.00	0.00	0.00	0.00	17.72	0.00
EQ	0.00	0.00	0.00	Included in EQ Calcs Above		

Notes: Load distributed along footing width (Stability Calculations - Bearing, Sliding & Overturning)

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Transverse Section	**Date:**	September 28, 2011

Buoyancy Forces

Note: Since the Saturated Unit Weight of water was not included in the Dead Load calculations, it is included here. In the calcs below, B1 is the bouyant force due to the footing, B2 is the bouyant force due to the steam and B3 is the bouyant force on the saturated soil. Since the geotech did not provide a saturated unti weight of soil, the dry unit weight is used. This is conservative.

HEIGHT OF STEM AT HIGH WATER:	11.84	
HEIGHT OF FOOTING AT HIGH WATER:	2.46	
WIDTH OF FOOTING	39.37	
SOIL WEIGHT - WATER WEIGHT	55.60	pcf
UPWARD BOUYANT FORCE	-62.40	pcf

NOTE: Horizontal load not applicable since the hydrostatic force is equal and opposite on both sides of the pier.

VERTICAL:

AREA #	VOLUME (CF)	GAMMA (#/CF)	Force (Kips)	Arm (Feet)	Moment (Ft x K)
B1	96.88	-62.40	-6.05	19.69	-119.00
B2	427.32	-62.40	-26.66	19.69	-524.89
B3	417.47	-62.40	-26.05	19.69	-512.79
SUM =			**-58.76**		**-1156.68**

HORIZONTAL:

Force = B(h) = (62.4-Ka*62.4)H^2/2, acts at HD/3:

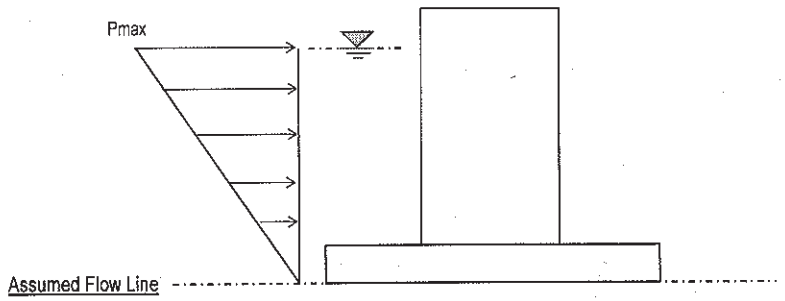
AREA #	Force (Kips)	Arm (Feet)	Moment (Ft x K)
STATIC	0.00	4.77	0.00
SEISMIC	0.00	4.77	0.00
SUM =	**0.00**		**0.00**

Stream Flow Pressure

Note: The flow line is conservatively assumed to act at the bottom of the footing

Pmax:	0.1960	ksf
APPLIED:	Y	

LOAD	HORIZONTAL		
	FORCE (Kips)	ARM (Feet)	MOM (Ft x K)
SF	1.40	9.53	13.36



Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Transverse Section	**Date:**	September 28, 2011

Service Load Group Summary - GROUP I

GROUP I: DL+LL+E+B+SF

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	D1	96.88	150.00	14.53	19.69	286.05			
	D2	550.57	150.00	82.59	19.69	1625.71			
	D3		150.00	0.00	0.00	0.00			
	D4		150.00	0.00	0.00	0.00			
	D5		150.00	0.00	0.00	0.00			
	Subtotal Concrete			***97.12***	***19.69***	***1911.76***			
	E TOT	417.47	118.00	49.26	19.69	969.71			
	E2		118.00	0.00	38.55	0.00			
	E3		118.00	0.00	19.69	0.00			
	E4		118.00	0.00	19.69	0.00			
	Subtotal Earth			***49.26***	***19.69***	***969.71***			
	Superstructure			***141.22***	***19.69***	***2780.00***			
	TOTAL DL			**287.60**		**5661.47**			
LL	**Superstructure**			96.22	19.69	1894.00			
	TOTAL LL			**96.22**		**1894.00**			
E	Pa(v) =			0.00	0.00	0.00			
	Pa(h) =						1.52	2.92	4.43
	Surch.	0.00	118.00	0.00	0.00	0.00			
	TOTAL E			**0.00**		**0.00**	**1.52**	**2.92**	**4.43**
B	B1(v) =			-6.05	19.69	-119.00			
	B2(v) =			-26.66	19.69	-524.89			
	B3(v) =			-26.05	19.69	-512.79			
	B(h) =						0.00	4.77	0.00
	TOTAL B			**-58.76**	**19.69**	**-1156.68**	**0.00**	**4.77**	**0.00**
SF	**TOTAL SF**						**1.40**	9.53	**13.36**
SUM				**325.06**		**6398.78**	**2.92**		**17.79**

Stability

	Resisting Moment (Ft x K)	Overturn Moment (Ft x K)	Vertical Force (Kips)	Horiz Force (Kips)
			14.53	
			31.76	
DL1 =	911.32	0.00	46.30	0.00
DL2 =	372.96	0.00	18.95	0.00
DL3 =	1069.23	0.00	54.32	0.00
DL =	2353.52	0.00	119.56	0.00
LL =	728.46	0.00	37.01	0.00
E =	0.00	4.43	0.00	1.52
B =	-444.88	0.00	-22.60	0.00
SF =	0.00	5.14	0.00	0.54
GROUP I =	2637.10	9.57	133.96	2.06

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Transverse Section	**Date:**	September 28, 2011

Service Load Group Summary - GROUP II & III

GROUP II: DL+E+B+W+SF

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	**TOTAL DL**			**287.60**		**5661.47**			
E	**TOTAL E**			**0.00**		**0.00**	**1.52**		**4.43**
B	**TOTAL B**			**-58.76**		**-1156.68**	**0.00**		**0.00**
W	Superstructure			-6.22		-170.81	5.99	20.89	125.10
	TOTAL W			**-6.22**		**-170.81**	**5.99**		**125.10**
SF	**TOTAL SF**						**1.40**	9.53	**13.36**
SUM				**222.63**		**4333.97**	**8.91**		**142.89**

Stability

	Resisting Moment (Ft x K)	Overturn Moment (Ft x K)	Vertical Force (Kips)	Horiz Force (Kips)
DL =	2353.52	0.00	119.56	0.00
E =	0.00	4.43	0.00	1.52
B =	-444.88	0.00	-22.60	0.00
W =	-65.70	48.11	-2.39	2.30
SF =	0.00	5.14	0.00	0.54
GROUP II =	1842.94	57.68	94.57	4.36

GROUP III: DL+LL+E+B+0.3*W+WL+LF+SF

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	**TOTAL DL**			**287.60**		**5661.47**			
LL	**TOTAL LL**			**96.22**		**1894.00**			
E	**TOTAL E**			**0.00**		**0.00**	**1.52**		**4.43**
B	**TOTAL B**			**-58.76**		**-1156.68**	**0.00**		**0.00**
W	**TOTAL W**			**-6.22**		**-170.81**	**5.99**		**125.10**
WL	Superstructure						1.00	29.16	29.15
	TOTAL WL						**1.00**		**29.15**
LF	Superstructure						0.00	29.16	0.00
	TOTAL LF						**0.00**		**0.00**
SF	**TOTAL SF**						**1.40**	9.53	**13.36**
SUM				**323.19**		**6347.54**	**5.71**		**84.47**

Stability

	Resisting Moment (Ft x K)	Overturn Moment (Ft x K)	Vertical Force (Kips)	Horiz Force (Kips)
DL =	2353.52	0.00	119.56	0.00
LL =	728.46	0.00	37.01	0.00
E =	0.00	4.43	0.00	1.52
B =	-444.88	0.00	-22.60	0.00
W =	-65.70	48.11	-2.39	2.30
WL =	0.00	11.21	0.00	0.38
LF =	0.00	0.00	0.00	0.00
SF =	0.00	5.14	0.00	0.54
GROUP III =	2617.39	35.21	133.25	3.13

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Transverse Section	**Date:**	September 28, 2011

Service Load Group Summary - GROUP IV, V & VI

GROUP IV: GROUP I + T

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
TOTAL GROUP I				**325.06**		**6398.78**	**2.92**		**17.79**
T	Superstructure						0.00	17.72	0.00
	TOTAL T						**0.00**		**0.00**
SUM				**325.06**		**6398.78**	**2.92**		**17.79**

	Stability Resisting Moment (Ft x K)	Stability Overturn Moment (Ft x K)	Stability Vertical Force (Kips)	Stability Horiz Force (Kips)
GROUP I =	2637.10	9.57	133.96	2.06
T =	0.00	0.00	0.00	0.00
GROUP IV =	2637.10	9.57	133.96	2.06

GROUP V: GROUP II + T

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
TOTAL GROUP II				**222.63**		**4333.97**	**8.91**		**142.89**
T	Superstructure						0.00	17.72	0.00
	TOTAL T						**0.00**		**0.00**
SUM				**222.63**		**4333.97**	**8.91**		**142.89**

	Stability Resisting Moment (Ft x K)	Stability Overturn Moment (Ft x K)	Stability Vertical Force (Kips)	Stability Horiz Force (Kips)
GROUP II =	1842.94	57.68	94.57	4.36
T =	0.00	0.00	0.00	0.00
GROUP V =	1842.94	57.68	94.57	4.36

GROUP VI: GROUP III + T

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
TOTAL GROUP III				**323.19**		**6347.54**	**5.71**		**84.47**
T	Superstructure						0.00	17.72	0.00
	TOTAL T						**0.00**		**0.00**
SUM				**323.19**		**6347.54**	**5.71**		**84.47**

	Stability Resisting Moment (Ft x K)	Stability Overturn Moment (Ft x K)	Stability Vertical Force (Kips)	Stability Horiz Force (Kips)
GROUP III =	2617.39	35.21	133.25	3.13
T =	0.00	0.00	0.00	0.00
GROUP VI =	2617.39	35.21	133.25	3.13

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Transverse Section	**Date:**	September 28, 2011

Service Load Group Summary - GROUP VII & I (CONSTRUCTION)

GROUP VII: DL+E+B+EQ+SF

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	**TOTAL DL**			**287.60**		**5661.47**			
E	**TOTAL E**			The earth pressure effects are included in EQ load.					
B	**TOTAL B**			**-58.76**		**-1156.68**	**0.00**		**0.00**
EQ	Pae(v)			0.00	0.00	0.00			
	Pae(h)						1.79	4.38	7.85
	Fwi						12.44	10.06	125.23
	Superstructure						13.85	21.22	293.87
	TOTAL E			**0.00**		**0.00**	**28.08**		**426.94**
SF	**TOTAL SF**						**1.40**	9.53	**13.36**
SUM				**228.84**		**4504.78**	**29.49**		**440.30**

Stability

	Resisting Moment (Ft x K)	Overturn Moment (Ft x K)	Vertical Force (Kips)	Horiz Force (Kips)
DL =	2353.52	0.00	119.56	0.00
E =	0.00	0.00	0.00	0.00
B =	-444.88	0.00	-22.60	0.00
EQ =	0.00	426.94	0.00	28.08
SF =	0.00	5.14	0.00	0.54
GROUP VII =	1908.64	432.08	96.96	28.62

GROUP I: DL+E - DURING CONSTRUCTION

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	Subtotal Concrete			97.12		1911.76			
	Subtotal Earth			49.26		969.71			
	TOTAL DL			**146.38**		**2881.47**			
E	Pa(v) =			0.00	0.00	0.00			
	Pa(h) =						1.52	2.92	4.43
	TOTAL E			**0.00**		**0.00**	**1.52**		**4.43**
SURCH				**0.00**		**0.00**	**0.00**		**0.00**
SUM				**146.38**		**2881.47**	**1.52**		**4.43**

Stability

	Resisting Moment (Ft x K)	Overturn Moment (Ft x K)	Vertical Force (Kips)	Horiz Force (Kips)
DL =	2353.52	0.00	119.56	0.00
E =	0.00	4.43	0.00	1.52
SC =	0.00	0.00	0.00	0.00
GROUP 1C =	2353.52	4.43	119.56	1.52

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Transverse Section	**Date:**	September 28, 2011

Check Overturning

CHECK OVERTURNING: (F.S. > 2.0) (F.S>1.5 for Group VII) (REF AASHTO 5.5.5)

GROUP I:

FS(overturning) = SUM Mr / Mo = 2637.10 / 9.57 = **275.63** **>2.0 O.K.**

GROUP II:

FS(overturning) = SUM Mr / Mo = 1842.94 / 57.68 = **31.95** **>2.0 O.K.**

GROUP III:

FS(overturning) = SUM Mr / Mo = 2617.39 / 35.21 = **74.33** **>2.0 O.K.**

GROUP IV:

FS(overturning) = SUM Mr / Mo = 2637.10 / 9.57 = **275.63** **>2.0 O.K.**

GROUP V:

FS(overturning) = SUM Mr / Mo = 1842.94 / 57.68 = **31.95** **>2.0 O.K.**

GROUP VI:

FS(overturning) = SUM Mr / Mo = 2617.39 / 35.21 = **74.33** **>2.0 O.K.**

GROUP VII:

FS(overturning) = SUM Mr / Mo = 1908.64 / 432.08 = **4.42** **>1.50 O.K.**

GROUP I - CONSTRUCTION:

FS(overturning) = SUM Mr / Mo = 2353.52 / 4.43 = **531.48** **>2.0 O.K.**

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Transverse Section	**Date:**	September 28, 2011

Check Sliding

Ignore the passive resistance of the soil since it may get washed away.

CHECK SLIDING: (F.S. > 1.5) (F.S. >1.125 for Group VII)

Ppass = 0 plf

F.S.(sliding) = $\frac{\text{Ppass + Sum V * Tan(phi)}}{\text{Sum H}}$

GROUP I:	0	+	133.96	*	0.500	=	**32.58**	**> 1.50 OK**
FS(sliding) =					2.06			
GROUP II:	0	+	94.57	*	0.500	=	**10.85**	**> 1.50 OK**
FS(sliding) =					4.36			
GROUP III:	0	+	133.25	*	0.500	=	**21.27**	**> 1.50 OK**
FS(sliding) =					3.13			
GROUP IV:	0	+	133.96	*	0.500	=	**32.58**	**> 1.50 OK**
FS(sliding) =					2.06			
GROUP V:	0	+	94.57	*	0.500	=	**10.85**	**> 1.50 OK**
FS(sliding) =					4.36			
GROUP VI:	0	+	133.25	*	0.500	=	**21.27**	**> 1.50 OK**
FS(sliding) =					3.13			
GROUP VII:	0	+	96.96	*	0.500	=	**1.69**	**> 1.125 OK**
FS(sliding) =					28.62			
GROUP I - CONSTRUCTION:	0	+	119.56	*	0.500	=	**39.41**	**> 1.50 OK**
FS(sliding) =					1.52			

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Transverse Section	**Date:**	September 28, 2011

Check Bearing Pressure

* - indicates the effect of buoyancy has been neglected.

GROUP :	I	II	III	IV	V	VI	VII	I-CON
Q =	133.96	94.57	133.25	133.96	94.57	133.25	96.96	119.56
Bv =	-22.60	-22.60	-22.60	-22.60	-22.60	-22.60	-22.60	
Q* =	156.56	117.17	155.85	156.56	117.17	155.85	119.56	119.56
Mr =	2637.10	1842.94	2617.39	2637.10	1842.94	2617.39	1908.64	2353.52
Mo =	9.57	57.68	35.21	9.57	57.68	35.21	432.08	4.43
Mnet =	2627.53	1785.26	2582.18	2627.53	1785.26	2582.18	1476.56	2349.09
Mb =	-444.88	-444.88	-444.88	-444.88	-444.88	-444.88	-444.88	
Mr* =	3081.98	2287.82	3062.27	3081.98	2287.82	3062.27	2353.52	2353.52
Mnet* =	3072.41	2230.14	3027.06	3072.41	2230.14	3027.06	1921.44	2349.09
e =	0.07	0.81	0.31	0.07	0.81	0.31	4.46	0.04
e* =	0.06	0.65	0.26	0.06	0.65	0.26	3.61	0.04
B/6 =	6.56	6.56	6.56	6.56	6.56	6.56	6.56	6.56
qheel =	3.37	2.11	3.23	3.37	2.11	3.23	0.79	3.02
qtoe =	3.44	2.70	3.54	3.44	2.70	3.54	4.14	3.05
qheel* =	3.94	2.68	3.80	3.94	2.68	3.80	1.36	3.02
qtoe* =	4.01	3.27	4.12	4.01	3.27	4.12	4.71	3.05
Allowable =	6.63	8.29	8.29	8.29	9.29	9.29	8.84	6.63
Kern (all) =	6.56	6.56	6.56	6.56	6.56	6.56	13.12	13.12
Bear. Check:	**O.K.**	**O.K.**	**O.K.**	**O.K.**	**O.K.**	**O.K.**	**O.K.**	**O.K.**
Kern Check:	**O.K.**	**O.K.**	**O.K.**	**O.K.**	**O.K.**	**O.K.**	**O.K.**	**O.K.**

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Transverse Section	**Date:**	September 28, 2011

Factored Load Group Summary - GROUP I & II

Per AASHTO Table 3.22.1A, for Load Factor Design, β_E = 1.3

GROUP I: 1.3*(DL+1.67*LL+E+B+SF)

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	**TOTAL DL**			**287.60**		**5661.47**			
1.67*LL	**TOTAL LL**			**160.68**		**3162.98**			
E	Pa(v) =			0.00	0.00	0.00			
	β_E*Pa(h) =						1.97	3.80	5.76
	Surch.	0.00	118.00	0.00	0.00	0.00			
	TOTAL E			**0.00**		**0.00**	**1.97**		**5.76**
B	**TOTAL B**			**-58.76**		**-1156.68**	**0.00**		**0.00**
SF	**TOTAL SF**						**1.40**		**13.36**
SUM				**506.38**		**9968.09**	**4.38**		**24.85**

GROUP II: 1.3(DL+E+B+W+SF)

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	**TOTAL DL**			**287.60**		**5661.47**			
E	**TOTAL E**			**0.00**		**0.00**	**1.97**		**5.76**
B	**TOTAL B**			**-58.76**		**-1156.68**	**0.00**		**0.00**
W	Superstructure						5.99	20.89	125.10
	TOTAL W			**-6.22**		**-170.81**	**5.99**		**125.10**
SF	**TOTAL SF**						**1.40**		**13.36**
SUM				**289.41**		**5634.17**	**12.17**		**187.48**

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Transverse Section	**Date:**	September 28, 2011

Factored Load Group Summary - GROUP III & IV

GROUP III: 1.3(DL+LL+E+B+0.3*W+WL+LF+SF)

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	**TOTAL DL**			**287.60**		**5661.47**	**0.00**		**0.00**
LL	**TOTAL LL**			**96.22**		**1894.00**	**0.00**		**0.00**
E	**TOTAL E**			**0.00**		**0.00**	**1.97**		**5.76**
B	**TOTAL B**			**-58.76**		**-1156.68**	**0.00**		**0.00**
W	**TOTAL W**			**-6.22**		**-170.81**	**5.99**		**125.10**
WL	Superstructure						1.00	29.16	29.15
	TOTAL WL						**1.00**	**0.00**	**29.15**
LF	Superstructure						0.00	29.16	0.00
	TOTAL LF						**0.00**	**0.00**	**0.00**
SF	**TOTAL SF**						**1.40**		**13.36**
SUM				**420.15**		**8251.80**	**8.02**		**111.54**

GROUP IV: 1.3*(DL+LL+E+B+T+SF)

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	**TOTAL DL**			**287.60**		**5661.47**			
LL	**TOTAL LL**			**96.22**		**1894.00**			
E	Pa(v) =			0.00		0.00			
	1.3*Pa(h) =						1.97	3.80	5.76
	Surch.	0.00	118.00	0.00	0.00	0.00			
	TOTAL E			**0.00**		**0.00**	**1.97**		**5.76**
B	**TOTAL B**			**-58.76**		**-1156.68**	**0.00**		**0.00**
T	Superstructure						0.00	17.72	0.00
	TOTAL T						**0.00**		**0.00**
SF	**TOTAL SF**						**1.40**		**13.36**
SUM				**422.58**		**8318.42**	**4.38**		**24.85**

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Transverse Section	**Date:**	September 28, 2011

Factored Load Group Summary - GROUP V, VI & VII

GROUP V: GROUP II * (1.25/1.30) + 1.25*T

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
TOTAL GROUP II				**289.41**		**5634.17**	**12.17**		**187.48**
T	Superstructure						0.00	17.72	0.00
	TOTAL T						**0.00**		**0.00**
SUM				**278.28**	**0.00**	**5417.47**	**11.70**	**0.00**	**180.27**

GROUP VI: GROUP III * (1.25/1.30) + 1.25*T

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
TOTAL GROUP III				**420.15**		**8251.80**	**8.02**		**111.54**
T	Superstructure						0.00	17.72	0.00
	TOTAL T						**0.00**		**0.00**
SUM				**403.99**	**0.00**	**7934.43**	**7.71**	**0.00**	**107.25**

GROUP VII: 1.3*(DL+E+B+EQ+SF)

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	**TOTAL DL**			**287.60**		**5661.47**			
E	**TOTAL E**			The earth pressure effects are included in EQ load.					
B	**TOTAL B**			**-58.76**		**-1156.68**	**0.00**		**0.00**
EQ	**TOTAL EQ**			**0.00**		**0.00**	**28.08**		**426.94**
SF	**TOTAL SF**						**1.40**		**13.36**
SUM				**297.50**		**5856.22**	**38.33**		**572.40**

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Transverse Section	**Date:**	September 28, 2011

Factored Toe Moment Calculation

* - indicates the effect of buoyancy has been neglected.

GROUP :	I	II	III	IV	V	VI	VII
Q =	506.38	289.41	420.15	422.58	278.28	403.99	297.50
Bv =	-76.39	-76.39	-76.39	-76.39	-73.45	-73.45	-76.39
Q* =	582.77	365.80	496.54	498.96	351.73	477.44	373.88
Mr =	9968.09	5634.17	8251.80	8318.42	5417.47	7934.43	5856.22
Mo =	24.85	187.48	111.54	24.85	180.27	107.25	572.40
Mnet =	9943.24	5446.69	8140.26	8293.56	5237.20	7827.18	5283.82
Mb =	-1503.69	-1503.69	-1503.69	-1503.69	-1445.85	-1445.85	-1503.69
Mr* =	11471.78	7137.86	9755.49	9822.11	6863.32	9380.28	7359.91
Mnet* =	11446.93	6950.38	9643.95	9797.25	6683.06	9273.03	6787.51
e =	0.05	0.87	0.31	0.06	0.87	0.31	1.92
e* =	0.04	0.68	0.26	0.05	0.68	0.26	1.53
B/6 =	6.56	6.56	6.56	6.56	6.56	6.56	6.56
qheel =	4.91	2.45	3.91	4.09	2.36	3.76	2.05
qtoe =	4.98	3.20	4.30	4.17	3.08	4.13	3.76
B' =	39.37	39.37	39.37	39.37	39.37	39.37	39.37
q2 =	4.98	3.17	4.28	4.16	3.05	4.12	3.69
Mtoe =	6.70	4.29	5.78	5.60	4.13	5.55	5.03
Vtoe =	8.17	5.22	7.04	6.83	5.02	6.77	6.11
qheel* =	5.66	3.20	4.66	4.84	3.08	4.48	2.80
qtoe* =	5.73	3.95	5.04	4.91	3.79	4.85	4.50
B'* =	39.37	39.37	39.37	39.37	39.37	39.37	39.37
q2* =	5.73	3.92	5.03	4.91	3.76	4.84	4.43
Mtoe* =	7.71	5.30	6.78	6.61	5.09	6.52	6.03
Vtoe* =	9.40	6.45	8.26	8.05	6.20	7.94	7.33

Max. Toe Moment =	**7.709**	kip*ft
Max. Toe Shear =	**9.397**	kips

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Transverse Section	**Date:**	September 28, 2011

Design Toe Reinforcement

DESIGN FOOTING TOE REINF (BOTTOM BARS):
(REF: AASHTO: 8.16.1.2, 8.16.3.2, 8.17.1)

Mu =	7.71	kip*ft
ASSUME COVER =	3.00	in.
HEIGHT FOOTING: h =	2.46	ft
phi =	0.90	
f'c =	4.00	ksi
fy =	60.00	ksi
d =	26.15	in. = h - cover - 1/2db(main) -db(stirup)
Sx =	1743.75	in^3
fcr =	474.34	psi
1.2*Mcr =	82.71	kip ft
a = Asfy/0.85f'cb =	0.65	in.
phi*Mn =	51.14	= phi[Asfy(d-a/2)]/12 kip ft.
As required for Mu:	0.0656	in^2
Min As (#4@18"):	0.1333	in^2
As(req'd) =	0.13 < 0.44	OK

USE # 6.00 @ 12.00 IN

	Bar #	As(bar)	db	Spg (in)	As prov (in^2)
Stirrup	0.00	0.00	0.00		
Flexural	6.00	0.44	0.75	12.00	0.44

CHECK SHEAR CAPACITY OF CONCRETE: (AASHTO 8.16.6.2)

Vc = 2*f'c^.5*bw*d

f'c =	4.00	
d =	26.15	
bw =	12.00	(per linear ft of heel)
phi =	0.85	
Vu =	9.40	kips
PHI*Vc =	33.74	O.K.

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Transverse Section	**Date:**	September 28, 2011

Factored Heel Moment Calculation

GROUP	I	II	III	IV	V	VI	VII
E3 =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
arm = BE/2 =	0.82	0.82	0.82	0.82	0.82	0.82	0.82
M3 = E3*arm =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Surcharge=	0.00	0.00	0.00	0.00	0.00	0.00	0.00
arm = BE/2 =	0.82	0.82	0.82	0.82	0.82	0.82	0.82
MSUR = SUR*arm =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HEEL CONC. =	0.79	0.79	0.79	0.79	0.79	0.79	0.79
arm = BE/2 =	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Mconc. =	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Pa(v) =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
arm = BE	1.64	1.64	1.64	1.64	1.64	1.64	1.64
Mpv =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vu =	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Mheel(top) =	0.65	0.65	0.65	0.65	0.65	0.65	0.65

Max. Heel Moment =	**0.646**	kip*ft
Max. Heel Shear =	**0.787**	kips

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Transverse Section	**Date:**	September 28, 2011

Design Heel Reinforcement

DESIGN FOOTING HEEL REINF (TOP BARS):

Mu =	0.65	kip*ft
ASSUME COVER =	2.00	in.
HEIGHT FOOTING: h =	2.46	ft
phi =	0.90	
f'c =	4.00	ksi
fy =	60.00	ksi
d =	27.15	in. = h - cover - 1/2db(main) -db(stirup)
Sx =	1743.75	in^3
fcr =	474.34	psi
1.2*Mcr =	82.71	kip ft
a = Asfy/0.85f'cb =	0.65	in.
phi*Mn =	53.12	= phi[Asfy(d-a/2)]/12 kip ft.
As required for Mu:	0.0053	in^2
Min As (#4@18"):	0.1333	in^2
As(req.) =	0.13 < 0.44	OK
USE #	6.00 @ 12.00	IN

	Bar #	As(bar)	db	Spg (in)	As prov (in^2)
Stirrup	0.00	0.00	0.00		
Flexural	6.00	0.44	0.75	12.00	0.44

CHECK SHEAR CAPACITY OF CONCRETE: (AASHTO 8.16.6.2)

Vc = 2*f'c^.5*bw*d

f'c =	4.00	
d =	27.15	
bw =	12.00	(per linear ft of heel)
phi =	0.85	
Vu =	0.79	kips
PHI*Vc =	35.03	O.K.

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Transverse Section	**Date:**	September 28, 2011

Compute the Lateral Loads on the Stem at Various Heights

Check the stem reinforcement at various locations along the stem and at the base of the backwall.

Height of Stem plus Backwall, h = H - F =	15.26	ft
Height of Backwall =	0.00	ft
Ftg Dowel Lap Length:	6.00	ft
Width of Stem at the Base:	36.09	ft
Width of Backwall:	0.00	ft
Width of Batter:	0.00	ft

Height of h	Height from top	Width Batter	Width conc	
1.00	15.26	0.00	36.09	<=== This section is at the bottom of the stem.
0.61	9.26	0.00	36.09	<=== This section is at the top of the footing dowel.
0.30	4.63	0.00	36.09	<=== This section is halfway in between top of footing dowel and top of stem.

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Transverse Section	**Date:**	September 28, 2011

Compute the Lateral Loads on the Stem at Various Heights Continued

CALCULATE EARTH PRESSURES AT EACH HEIGHT:

h = 15.26

hi	Kai	Gamma	Fi	Pi(h)	ARM	M
0	0.33	118.000	0.00	0.000	15.26	0.00
6.2992126	0.33	118.000	0.00	0.000	3.15	0.00
6.2992126	0.33	118.000	0.25	0.750	2.10	1.57
SUM =				**0.75**	**2.10**	**1.57**

h = 9.26

hi	Kai	Gamma	Fi	Pi(h)	ARM	M
0	0.33	118.000	0.00	0.000	9.26	0.00
6.2992126	0.33	118.000	0.00	0.000	3.15	0.00
6.2992126	0.33	118.000	0.25	0.750	2.10	1.57
SUM =				**0.75**	**2.10**	**1.57**

h = 4.63

hi	Kai	Gamma	Fi	Pi(h)	ARM	M
0	0.33	118.000	0.00	0.000	4.63	0.00
6.2992126	0.33	118.000	0.00	0.000	3.15	0.00
6.2992126	0.33	118.000	0.25	0.750	2.10	1.57
SUM =				**0.75**	**2.10**	**1.57**

CALCULATE SEISMIC PRESSURES AT EACH HEIGHT:

h = 15.26

hi	Kai	Gamma	Fi	Pae(h)i	ARM	M
0	0.40	118.000	0.00	0.000		
6.2992126	0.40	118.000	0.00	0.000		
6.2992126	0.40	118.000	0.29	0.886		
SUM =				**0.89**	**3.15**	**2.79**

h = 9.26

hi	Kai	Gamma	Fi	Pae(h)i	ARM	M
0	0.40	118.000	0.00	0.000		
6.2992126	0.40	118.000	0.00	0.000		
6.2992126	0.40	118.000	0.29	0.886		
SUM =				**0.89**	**3.15**	**2.79**

h = 4.63

hi	Kai	Gamma	Fi	Pae(h)i	ARM	M
0	0.40	118.000	0.00	0.000		
6.2992126	0.40	118.000	0.00	0.000		
6.2992126	0.40	118.000	0.29	0.886		
SUM =				**0.89**	**3.15**	**2.79**

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Transverse Section	**Date:**	September 28, 2011

Compute the Lateral Loads on the Stem at Various Heights Continued

h =	15.26	W =	36.09				
GROUP:	I	II	III	IV	V	VI	VII
DL =	183.59	183.59	183.59	183.59	176.53	176.53	183.59
arm =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MDL =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LL =	208.88		125.08	125.08		120.27	
arm =	0.00		0.00	0.00		0.00	
MLL =	0.00		0.00	0.00		0.00	
Pa(h) =	1.27	1.27	1.27	1.27	1.27	1.22	
arm =	2.10	2.10	2.10	2.10	2.10	2.10	
MPa(h) =	2.66	2.66	2.66	2.66	2.66	2.56	
B =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
arm =	3.95	3.95	3.95	3.95	3.95	3.95	3.95
MB =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wpier =		1.58	0.48		1.52	0.46	
arm =		10.78	10.78		10.78	10.78	
MW =		17.08	5.12		16.42	4.93	
Wsuper =		6.20	1.86		5.96	1.79	
arm =		20.39	20.39		20.39	20.39	
MW =		126.39	37.92		121.53	36.46	
WL =			1.30			1.25	
arm =			26.70			26.70	
MWL =			34.70			33.36	
LF =			0.00			0.00	
arm =			26.70			26.70	
MLF =			0.00			0.00	
T =				0.00	0.00	0.00	
arm =				15.26	15.26	15.26	
MT =				0.00	0.00	0.00	
Pae(h) =							1.15
arm =							3.15
MPae(h) =							3.63
Fwi =							16.17
arm =							7.63
MFwi =							123.38
EQ =							18.01
arm =							18.76
MEQ =							337.72
Mtotal =	**2.66**	**146.13**	**80.40**	**2.66**	**140.61**	**77.31**	**464.73**
Vtotal =	**1.27**	**9.05**	**4.90**	**1.27**	**8.75**	**4.71**	**35.33**

h =	9.26	W =	36.09				
GROUP:	I	II	III	IV	V	VI	VII
DL =	183.59	183.59	183.59	183.59	176.53	176.53	183.59
arm =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MDL =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LL =	208.88		125.08	125.08		120.27	
arm =	0.00		0.00	0.00		0.00	
MLL =	0.00		0.00	0.00		0.00	
Pa(h) =	1.27	1.27	1.27	1.27	1.22	1.22	
arm =	2.10	2.10	2.10	2.10	2.10	2.10	
MPa(h) =	2.66	2.66	2.66	2.66	2.56	2.56	
B =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
arm =	1.95	1.95	1.95	1.95	1.95	1.95	1.95
MB =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wpier =		1.58	0.48		1.52	0.46	
arm =		4.78	4.78		4.78	4.78	
MW =		7.57	2.27		7.28	2.18	
Wsuper =		6.20	1.86		5.96	1.79	
arm =		14.39	14.39		14.39	14.39	
MW =		89.19	26.76		85.76	25.73	
WL =			1.30			1.25	
arm =			20.70			20.70	
MWL =			26.90			25.87	
LF =			0.00			0.00	
arm =			20.70			20.70	
MLF =			0.00			0.00	
T =				0.00	0.00	0.00	
arm =				9.26	9.26	9.26	
MT =				0.00	0.00	0.00	
Pae(h) =							1.15
arm =							3.15
MPae(h) =							3.63
Fwi =							9.81
arm =							4.63
MFwi =							45.42
EQ =							18.01
arm =							12.76
MEQ =							229.68
Mtotal =	**2.66**	**99.42**	**58.59**	**2.66**	**95.60**	**56.34**	**278.73**
Vtotal =	**1.27**	**9.05**	**4.90**	**1.27**	**8.70**	**4.71**	**28.97**

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Transverse Section	**Date:**	September 28, 2011

Compute the Lateral Loads on the Stem at Various Heights Continued

h =	4.63	W =	36.09				
GROUP:	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**
DL =	183.59	183.59	183.59	183.59	176.53	176.53	183.59
arm =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MDL =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LL =	208.88		125.08	125.08		120.27	
arm =	0.00		0.00	0.00		0.00	
MLL =	0.00		0.00	0.00		0.00	
Pa(h) =	1.27	1.27	1.27	1.27	1.22	1.22	
arm =	2.10	2.10	2.10	2.10	2.10	2.10	
MPa(h) =	2.66	2.66	2.66	2.66	2.56	2.56	
B =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
arm =	0.40	0.40	0.40	0.40	0.40	0.40	0.40
MB =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wpier =		1.58	0.48		1.52	0.46	
arm =		0.15	0.15		0.15	0.15	
MW =		0.23	0.07		0.23	0.07	
Wsuper =		6.20	1.86		5.96	1.79	
arm =		9.76	9.76		9.76	9.76	
MW =		60.50	18.15		58.17	17.45	
WL =			1.30			1.25	
arm =			16.07			16.07	
MWL =			20.89			20.08	
LF =			0.00			0.00	
arm =			16.07			16.07	
MLF =			0.00			0.00	
T =				0.00	0.00	0.00	
arm =				4.63	4.63	4.63	
MT =				0.00	0.00	0.00	
Pae(h) =							1.15
arm =							3.15
MPae(h) =							3.63
Fwi =							4.91
arm =							2.31
MFwi =							11.35
EQ =							18.01
arm =							8.13
MEQ =							146.35
Mtotal =	**2.66**	**63.39**	**41.77**	**2.66**	**60.96**	**40.16**	**161.33**
Vtotal =	**1.27**	**9.05**	**4.90**	**1.27**	**8.70**	**4.71**	**24.06**

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Transverse Section	**Date:**	September 28, 2011

Stem Reinforcement (REF: AASHTO: 8.16.1.2, 8.16.3.2, 8.17.1)

	SECT 1	SECT 2	SECT 3	
SECTION HEIGHT =	15.26	9.26	4.63	ft
MOMENT =	464.73	278.73	161.33	k*ft
ASSUME COVER =	2.00	2.00	2.00	in
H OF STEM:	36.09	36.09	36.09	ft
phi =	0.90	0.90	0.90	
f'c =	4.00	4.00	4.00	ksi
fy =	60.00	60.00	60.00	ksi
stirup size # =	0.00	0.00	0.00	
BAR # =	6.00	6.00	6.00	
SPACING =	7.00	12.00	12.00	in
Stirup Abar =	0.00	0.00	0.00	in^2
Main Abar =	0.44	0.44	0.44	in^2
Stirup db =	0.00	0.00	0.00	in
Main db =	0.75	0.75	0.75	in
As provd. =	0.75	0.44	0.44	in^2
d =	430.70	430.70	430.70	in
4/3*As(req.) =	0.32	0.19	0.11	in^2
As provided =	0.75	0.44	0.44	in^2
Flexure OK?	OK	OK	OK	
a = Asfy/0.85f'cb =	1.11	0.65	0.65	in
phi*Mn =phi[Asfy(d-a/2)]/12 kip ft.	1460.02	852.14	852.14	kip*ft
1.2*Mcr=	17597.97	17597.97	17597.97	
Vu =	35.33	28.97	24.06	kips
bw (per linear ft of wall) =	12.00	12.00	12.00	in
phi =	0.85	0.85	0.85	
phiVc = phi*2*f'c^.5*bw*d	555.69	555.69	555.69	kips
Shear OK?	OK	OK	OK	

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PIER LONGITUDINAL DESIGN

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Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Longitudinal Section	**Date:**	September 28, 2011

References:

AASHTO Standard Specification for Highways and Bridges, 17th Edition, 2002
ACI 318-05 Building Code Requirements for Structural Concrete, 2005
MassHighway Bridge Manual, 2005

Notes:

General Design Parameters

LONGITUDINAL SECTION CUT

GEOMETRY INFORMATION INPUT:

PROPOSED TOP OF ROADWAY ELEV:	3900.56	ft	1188.690	m
PROPOSED TOP OF PIER ELEV:	3895.11	ft	1187.231	m
PROPOSED TOP OF FOOTING ELEV:	3879.86	ft	1182.581	m
PROPOSED BOT. OF FOOTING ELEV:	3877.40	ft	1181.831	m
ELEVATION OF HIGH WATER:	3890.06	ft	1185.690	m
PROPOSED PIER THICKNESS (AT TOP):	4.92	ft	1.50	m
PROPOSED PIER THICKNESS (AT BOTTOM):	4.92	ft	1.50	m
PROPOSED FOOTING LENGTH:	9.84	ft	3.00	m
PROPOSED PIER WIDTH:	36.09	ft	11.00	m
PROPOSED FOOTING WIDTH:	39.37	ft	12.00	m

MATERIAL PROPERTIES:

CUBIC WEIGHT CONCRETE:	150.00	lbs/CF
COMP. STRENGTH OF CONC. = F'c:	4.00	ksi
TENSILE STRENGTH OF REBAR = Fy:	60.00	ksi

GEOTECHNICAL INFORMATION:

WEIGHT OF SOIL BACKFILL (STRATA 1):	118.00	Lbs/CF		
WEIGHT OF SOIL BACKFILL (STRATA 2):	118.00	Lbs/CF		
ALLOWABLE BEARING CAPACITY:	6.63	ksf		
WALL ON LEDGE:	N	(Y OR N)		
WALL ON PILES:	N	(Y OR N)		
BETA: SLOPE OF BACKFILL:	0.00	DEG	RAD =	0.0000
PHI: FRICTION ANGLE FOR SLIDING:	26.56	DEG	RAD =	0.4636
DELTA 1: ANGLE BACKWALL FRICTION:	17.00	DEG	RAD =	0.2967
DELTA 2: ANGLE BACKWALL FRICTION:	17.00	DEG	RAD =	0.2967
THETA: BATTER ANGLE BACKWALL:	90.00	DEG	RAD =	1.5708
PHI 1: FRICTION ANGLE OF BACKFILL:	27.00	DEG	RAD =	0.4712
PHI 2: FRICTION ANGLE OF BACKFILL:	27.00	DEG	RAD =	0.4712
COEFFICIENT OF ACTIVE PRESSURE, Ka:	0.33			

STREAM PRESSURE

Pmax:	196.00	psf
CONSIDER STREAM FLOW:	N	

APPLIED ONLY IN THE TRANSVERSE DIRECTION

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Longitudinal Section	**Date:**	September 28, 2011

General Loading Parameters

LIVE LOAD INFORMATION:

APPROACH SLAB:	N	(Y OR N)
ROADWAY WITHIN H/2 OF TOP OF WALL:	N	(Y OR N)
CONSIDER LL SURCHARGE ?	N	(Y OR N)
SURCHARGE HEIGHT:	0.00	ft
CONSTRUCTION SURCHARGE:	0.00	psf

SEISMIC LOAD INFORMATION:

WALL RESTRAINED HORZ. MOVMT.(Y/N):	N	(Y OR N) <---- Superstructure has been designed to accommodate the movement required.
SEISMIC ACCELERATION COEFF. A:	0.17	REF: FIG.32A Div IA, AASHTO
SEISMIC CATEGORY:	B	REF: Table 3.4 Div IA, AASHTO

ADDITIONAL LOADS ON STRUCTURE (load is per linear foot of structure, arm from front edge of pier)

		Beam 1 Rxn (kips)	Beam 2 Rxn (kips)	Beam 3 Rxn (kips)	Beam 4 Rxn (kips)	Beam 5 Rxn (kips)	Total Super Rxn (kips)	LOAD (klf)	ARM (feet)	
SUPERSTRUCT. DEAD LOAD:	DL						695.00	19.26	2.46	
LIVE LOAD (NO IMPACT):	LL						473.50	13.12	2.46	
WIND ON STRUCTURE: (PIER)	W_S						10.50	0.29	4.48	<---Apply halfway up exposed stem
WIND ON SUPERSTRUCTURE:	W_T						0.10	0.00	5.13	
UPLIFT :	W_U						0.00	0.00	0.00	
WIND LOAD ON LIVE LOAD:	WL						4.92	0.14	11.44	
LONGITUDINAL & FRICTION:	LF						8.45	0.23	11.44	
THERMAL FORCE:	T						0.00	0.00	0.00	
SEISMIC LOAD ON SUPERSTRUCT:	EQ						177.23	4.50	3.50	<--- Apply at the centroid of superstructure

Note: Load (kips per linear foot of pier)

Intermediate Pier Design

General Information

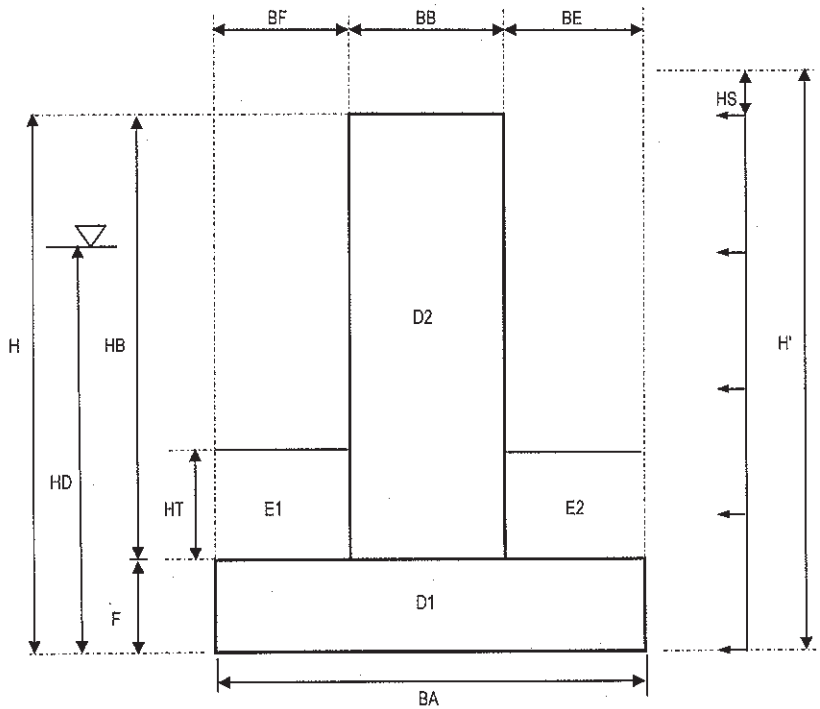
Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Longitudinal Section	**Date:**	September 28, 2011

Pier Geometry

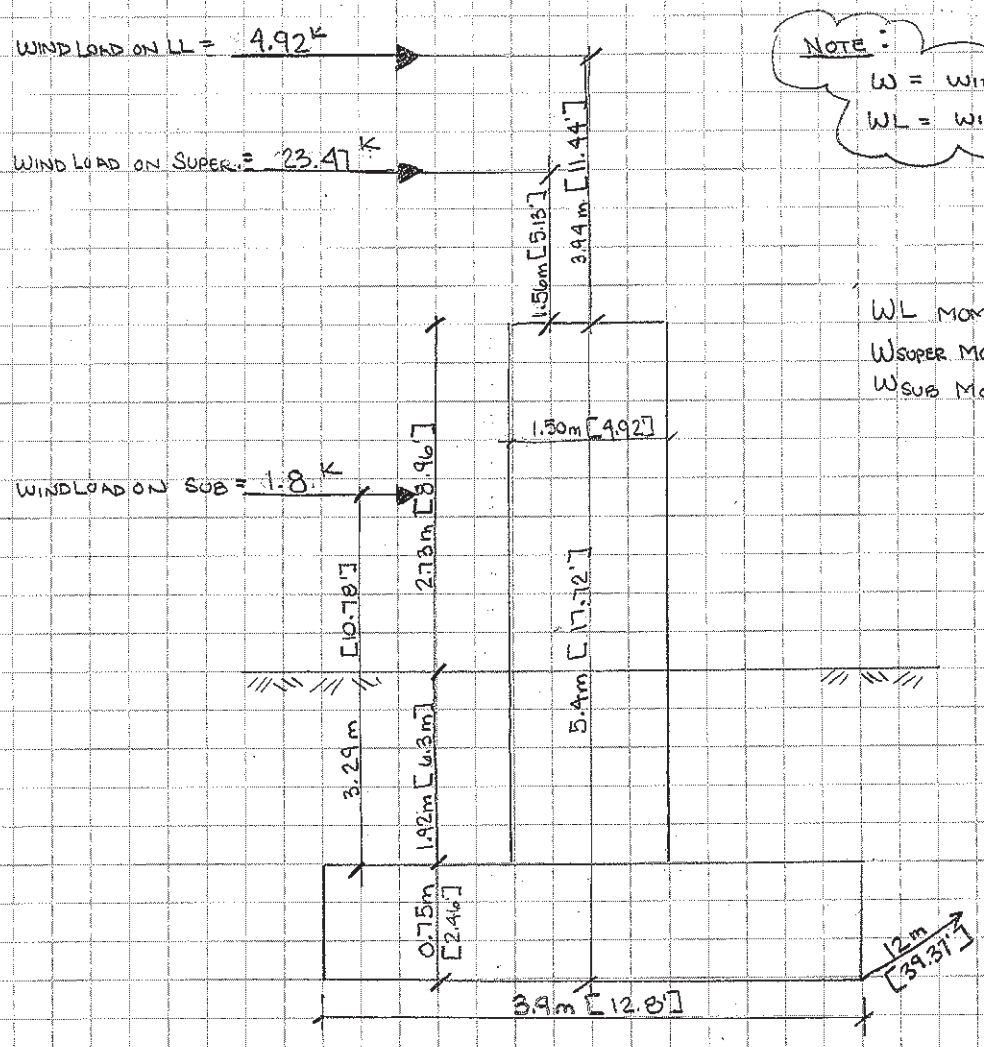
LONGITUDINAL SECTION CUT

CALCULATION OF WALL AND BACKFILL GEOMETRY:

	Prelim Size	User Adjust	Final Size	Final Size (m)
HEIGHT OF PIER, H:	17.717	0.00	17.72	5.40
HEIGHT OF FOOTING, F:	2.000	0.46	2.46	0.75
HEIGHT OF STEM, HB:	15.256	0.00	15.26	4.65
HEIGHT OF HIGH WATER, HD:	12.661	0.00	12.66	3.86
HEIGHT OF SURCHARGE, HS:	0.000	0.00	0.00	0.00
THEORETICAL HEIGHT W/ SURCHARGE, H':	17.717	0.00	17.72	5.40
LENGTH OF FOOTING, BA:	10.000	2.80	12.80	3.90
LENGTH OF WALL AT TOP, BB:	4.921	0.00	4.92	1.50
LENGTH OF FOOTING HEEL, BE	3.937	0.00	3.94	1.20
LENGTH OF FOOTING TOE, BF:	3.937	0.00	3.94	1.20
HEIGHT OF SOIL OVER TOE, HT:	6.299	0.00	6.30	1.92
HEIGHT OF SOIL	8.760	0.00	8.76	2.67
WIDTH OF FOOTING:	39.370	0.00	39.37	12.00



BEARING PRESSURE - HAND CALC



NOTE:
W = WIND ON SUPER & SUB
WL = WIND ON LIVE LOAD

WL MOMENT ARM = 29.16'
WSUPER MOMENT ARM = 22.85'
WSUB MOMENT ARM = 13.24'

SERVICE LOAD FACTORS

GROUP II & V: $1.0 * W + 0.0 * WL \rightarrow 1.0[23.47 * (5.13 + 17.72) + 1.8(10.78 + 2.46)] = 560.12^{K\text{-}FT}$

GROUP III & VI: $0.3 * W + 1.0 * WL \rightarrow 0.3[23.47(5.13 + 17.72) + 1.8(10.78 + 2.46)] + 1[4.92(11.44 + 17.72)] = 311.5^{K\text{-}FT}$

SECTION MODULUS OF FOOTING

$S = bh^2/6 = (12.8)(39.37')^2/6 = 3307\ FT^3$

TETRA TECH One Grant Street Framingham, MA 01701-9005 (508) 903-2000	JOB KHOST BRIDGE SHEET NO. B.P. LONG PIER OF CALCULATED BY nav DATE 9/27/11 CHECKED BY JL DATE 9/28/11 SCALE

BEARING PRESSURE - HAND CALC (CONT.)

BEARING PRESSURE TO BE ADDED:

GROUP II & V: 560.12 K-FT / 3307 FT³ = 0.169 KSF

GROUP III & VI: 311.5 K-FT / 3307 FT³ =

FINAL BEARING PRESSURES

SEE LONG. PIER DESIGN

GROUP II:	3.33	+	0.169 =	3.499	<	8.29	OK
GROUP III:	4.54	+	0.094 =	4.634	<	8.29	OK
GROUP V:	3.33	+	0.169 =	3.499	<	9.29	OK
GROUP VI:	4.54	+	0.094 =	4.634	<	9.29	OK

TETRA TECH

One Grant Street
Framingham, MA 01701-9005
(508) 903-2000

JOB KHOST BRIDGE
SHEET NO. B.P. LONG. PIER OF
CALCULATED BY nav DATE 9/27/11
CHECKED BY JZ DATE 9/28/11
SCALE

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Longitudinal Section	**Date:**	September 28, 2011

Results Summary:

STABILITY RESULTS:

GROUP:	I	II	III	IV	V	VI	VII	I-CON
OVERTURNING:	62.06	24.68	17.84	62.06	24.68	17.84	1.64	56.14
F.S.allowable = 2.00	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
SLIDING:	14.16	8.66	11.09	14.16	8.66	11.09	1.88	12.81
F.S.allowable = 1.50	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
Max BP (with Bouy):	3.52	2.71	3.92	3.52	2.71	3.92	8.27	3.20
Max BP (w/o Bouy):	4.14	3.33	4.54	4.14	3.33	4.54	7.46	3.20
ALLOWABLE:	6.63	8.29	8.29	8.29	9.29	9.29	8.84	6.63
Bear. Check:	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
Kern Check:	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.

REINFORCEMENT RESULTS:

= As Provided / As Required

	STIRUP #	BAR #	SPAC.	REINF. RATIO	FLEX OK?	LBS./ L.F.	LENGTH OF BAR	No. Bars per ft	Wt. of bar PER L.F.	As/LF	SHEAR OK?
TOE(bot):	0.00	6.00	7.00	1.40	OK	31.56	12.30	1.71	1.50	0.44	OK
HEEL(top):	0.00	6.00	12.00	3.30	OK	18.41	12.30	1.00	1.50	0.44	OK
STEM 1 (at top of ftg):	0.00	6.00	7.00	1.08	OK	23.00	8.96	1.71	1.50	0.44	OK
STEM 2 (at top of ftg dwl):	0.00	6.00	10.00	1.18	OK	26.81	14.92	1.20	1.50	0.44	OK
STEM 3 (midpt back face):	0.00	6.00	12.00	1.59	OK	0.00	0.00	1.00	1.50	0.44	OK
TOTAL WT. STEEL/FT OF ABUT.=						99.78	LBS./LF				

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Longitudinal Section	**Date:**	September 28, 2011

Calculate Earth Pressure

These lateral earth pressure calculations include the effects of additional lateral earth pressure due to live load surcharge, if applicable.

Per AASHTO 3.20.3, when highway traffic can come within a horizontal distance from the top of the structure equal to 1/2 its height, the pressure shall have added to it a live load surcharge pressure qual to not less than 2 feet of earth. This surcharge is to be treated an an additional earth pressure.

Coulomb's Active Earth Pressure:

	STRATA 1			STRATA 2	
GAMMA =	118.00		GAMMA =	118.00	
Height of Earth =	8.76	Feet	Height of Earth =	8.76	Feet
THETA =	90.00	Degrees:	THETA =	90.00	Degrees:
BETA =	0.00	Degrees:	BETA =	0.00	Degrees:
PHI =	27.00	Degrees:	PHI =	27.00	Degrees:
DELTA =	17.00	Degrees:	DELTA =	17.00	Degrees:
Ka (1) =	**0.335**		**Ka (2) =**	**0.335**	

At-Rest Earth Pressure Coeff:

	STRATA 1		STRATA 2
Ko (1) =	**0.546**	**Ko (2) =**	**0.546**

Earth Pressure Coefficient to be Used for Design:

Design of walls on rock or piles shall use Ko. Cantilever walls shall use Ka. Active pressure coefficients shall be estimated using Coulomb Theory.

WALL ON LEDGE:	N	(Y OR N)
WALL ON PILES:	N	(Y OR N)
Wall Height:	17.7165354	ft
Earth pressure Type:	Ka	

	STRATA 1		STRATA 2
Ke (1) =	**0.335**	**Ke (2) =**	**0.335**

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Longitudinal Section	**Date:**	September 28, 2011

Calculate Earth Pressure Cont.

Pi(h) =1/2(Ke)(Gamma)(hi^2)cos(90-theta+delta)
Pi(v) =1/2(Ke)(Gamma)(hi^2)sin(90-theta+delta)

Note: These equations are shown, but not used in the final loads. Due to the small height of earth, it is assumed the lateral earth pressure will act horizontal.

Compute Earth Loads and Moments:

	hi	Kai	Gamma	Fi	Pi	DELTA	Pi(h)	ARM	Mi	Pi(v)	ARM	Mi
1	0.00	0.335	118.00	0.000	0.00	17.00	0.00	8.76	0.00	0.00	12.80	0.00
2	8.76	0.335	118.00	0.000	0.00	17.00	0.00	4.38	0.00	0.00	12.80	0.00
3	8.76	0.335	118.00	0.346	1.52	17.00	1.45	2.92	4.23	0.44	12.80	5.67
SUM =					**1.52**		**1.52**	**2.92**	**4.43**	**0.00**	**0.00**	**0.00**

Design based on Equivalent Fluid Pressure:

n/a

EFPa, Above Water =	0.00	pcf
EFPb, Below Water =	0.00	pcf
Earth Height =	8.75984252	ft
H Under Water, HD=	8.75984252	ft
H Above Water, H1=	0	ft

Pi(h) =1/2(EFP)(hi^2)
Pi(v) =0

Compute Earth Loads and Moments per Geotech Report:

	hi	Kai	Gamma	Fi	Pi	DELTA	Pi(h)	ARM	Mi	Pi(v)	ARM	Mi
1	0.00	0.546	118.00	0.000	0.00		0.00	8.76	0.00			
2	8.76	0.546	118.00	0.000	0.00		0.00	4.38	0.00			
3	8.76	0.546	118.00	0.000	0.00		0.00	2.92	0.00			
SUM =					**0.00**		**0.00**	**2.92**	**0.00**	**0.00**	**0.00**	**0.00**

SUMMARY AND RESULTANT OF EARTH PRESSURES (to be used for design):

	FORCE (Kips)	ARM (Feet)	MOM (Ft x K)
Pa(v) =	0.00	0.00	0.00
Pa(h) =	1.52	2.92	4.43
Pa =	**1.517**		

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Longitudinal Section	**Date:**	September 28, 2011

Calculate Seismic Forces

(Ref: AASHTO DIV1A, Section 6.4 and 1998 Commentary C6.4.3 for Mononobe-Okabe Analysis.) - Mononobe

	STRATA 1				STRATA 2			
GAMMA =	118.00	Lbs/CF			118.00	Lbs/CF		
Height of Earth =	8.76	Feet			8.76	Feet		
PHI =	27.00	Degrees =	0.47	Radians	27.00	Degrees =	0.47	Radians
THETA =	4.86	Degrees =	0.08	Radians	4.86	Degrees =	0.08	Radians
DELTA =	17.00	Degrees =	0.30	Radians	17.00	Degrees =	0.30	Radians
A =	0.17				0.17			
kh =	0.085				0.085			
i =	0.00	Degrees =	0.00	Radians	0.00	Degrees =	0.00	Radians
BETA =	0.00	Degrees =	0.00	Radians	0.00	Degrees =	0.00	Radians

SEISMIC ACTIVE EARTH PRESSURE (AASHTO 1998 Commentary, C6.4.3)

Kae (1) = 0.396 **Kae (2) =** 0.396

Pi(h) =1/2(Ke)(Gamma)(hi^2)cos(90-theta+delta)
Pi(v) =1/2(Ke)(Gamma)(hi^2)sin(90-theta+delta)

Note: These equations are shown, but not used in the final loads. Due to the small height of earth, it is assumed the lateral seismic pressure will act horizontal.

Compute Seismic Loads and Moments:

	hi	Kai	Gamma	Fi	Pi	DELTA	Pi(h)	ARM	Mi	Pi(v)	ARM	Mi
1	0.00	0.396	118.00	0.000	0.00	17	0.00			0.00		
2	8.76	0.396	118.00	0.000	0.00	17	0.00			0.00		
3	8.76	0.396	118.00	0.409	1.79	17	1.71			0.52		
SUM =					**1.79**		**1.79**	**4.38**	**7.85**	**0.00**	**0.00**	**0.00**

RESULTANT OF SEISMIC EARTH PRESSURE: (AASHTO 1998 Commentary, C6.4.3)

Pae = GAMMAxKaH^2/2 =

Eae=Pae = 1.792 Kips
ASSUME Pae ACTS AT H/2 = 4.380 ft

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Longitudinal Section	**Date:**	September 28, 2011

Calculate Seismic Forces Cont.

WALL INERTIA EFFECTS

Per AASHTO DIV 1A 6.4.3, seismic design should take into account forces arising from seismically induced lateral earth pressures (as computed above), additional forces arising from wall inertia and the transfer of seismic forces from the bridge deck through bearing supports which do not slide freely.

The following table computes the inertia forces due to the weight of the concrete and backfill.

kh = 0.085

	AREA #	DL (Kips)	DL*kh (Kips)	ARM (Feet)	MOM (Ft x K)
DL Wall	D1	4.72	0.40	1.23	0.49
	D2	11.26	0.96	10.09	9.66
	D3	0.00	0.00	17.72	0.00
	D4	0.00	0.00	7.55	0.00
	D5	0.00	0.00	0.00	0.00
	Subtotal	**15.98**	**1.36**	**7.47**	**10.15**
DL Backfill	E1	6.72	0.57	12.63	7.21
	E2	0.00	0.00	17.72	0.00
	E3	0.00	0.00	10.09	0.00
	E4	0.00	0.00	5.61	0.00
	Subtotal	**6.72**	**0.57**	**12.63**	**7.21**
TOTAL		**22.70**	**1.93**	**9.00**	**17.36**

SUMMARY OF SEISMIC LOADS:

	FORCE (Kips)	ARM (Feet)	MOM (Ft x K)
Pae(v) = Pae x SIN(90-TH+DEL) =	0.00	0.00	0.00
Pae(h) = Pae x COS(90-TH+DEL) =	1.79	4.38	7.85
Fwi(h) = kh x Wbackfill =	1.93	9.00	17.36
EQ Superstructure =	4.50	21.22	95.51

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Longitudinal Section	**Date:**	September 28, 2011

Construction Surcharge <-- N/A

Consider the following surcharge during construction. <--- NOT APPLICABLE - NO SURCHARGE

Pcon(h) = p*H*Length =	0.00	kips
MconOT = Pconh*H/2 =	0.00	kip*ft
Pcon(v) = q*BE*Length =	0.00	kips
MconR = Pconv*(BA-BE/2) =	0.00	kip*ft

Loads from Superstructure

LOADS FOR FACTORED LOAD GROUPS - REINFORCEMENT

LOAD	VERTICAL			HORIZONTAL		
	FORCE (Kips)	ARM (Feet)	MOM (Ft x K)	FORCE (Kips)	ARM (Feet)	MOM (Ft x K)
DL	19.26	6.40	123.20	-	-	-
LL	13.12	6.40	83.94	-	-	-
W_S	-	-	-	0.29	13.24	3.85
W_T	-	-	-	0.00	22.85	0.06
W_U	0.00	3.94	0.00	-	-	-
W (total)	0.00	3.94	0.00	0.29	13.33	3.91
WL	-	-	-	0.14	29.16	3.98
LF	-	-	-	0.23	29.16	6.83
T	-	-	-	0.00	17.72	0.00
EQ	-	-	-	Included in EQ Calcs Above		

Notes: Load distributed along pier width
Wind load on pier conservatively taken at top of pier

LOADS FOR SERVICE LOAD GROUP - STABILITY

LOAD	VERTICAL			HORIZONTAL		
	FORCE (Kips)	ARM (Feet)	MOM (Ft x K)	FORCE (Kips)	ARM (Feet)	MOM (Ft x K)
DL	17.65	6.40	112.94	0.00	0.00	0.00
LL	12.03	6.40	76.94	0.00	0.00	0.00
W_S	0.00	0.00	0.00	0.27	13.24	3.53
W_T	0.00	0.00	0.00	0.00	22.85	0.06
W_U	0.00	3.94	0.00	0.00	0.00	0.00
W (total)	0.00	3.94	0.00	0.27	13.33	3.59
WL	0.00	0.00	0.00	0.12	29.16	3.64
LF	0.00	0.00	0.00	0.21	29.16	6.26
T	0.00	0.00	0.00	0.00	17.72	0.00
EQ	0.00	0.00	0.00	Included in EQ Calcs Above		

Notes: Load distributed along footing width (Stability Calculations - Bearing, Sliding & Overturning)

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Longitudinal Section	**Date:**	September 28, 2011

Buoyancy Forces

Note: Since the Saturated Unit Weight of water was not included in the Dead Load calculations, it is included here. In the calcs below, B1 is the bouyant force due to the footing, B2 is the bouyant force due to the steam and B3 is the bouyant force on the saturated soil. Since the geotech did not provide a saturated unti weight of soil, the dry unit weight is used. This is conservative.

HEIGHT OF STEM AT HIGH WATER:	10.20	
HEIGHT OF FOOTING AT HIGH WATER:	2.46	
WIDTH OF FOOTING	12.80	
SOIL WEIGHT - WATER WEIGHT	55.60	pcf
UPWARD BOUYANT FORCE	62.40	pcf

NOTE: Horizontal load not applicable since the hydrostatic force is equal and opposite on both sides of the pier.

VERTICAL:

AREA #	VOLUME (CF)	GAMMA (#/CF)	Force (Kips)	Arm (Feet)	Moment (Ft x K)
B1	31.48	-62.40	-1.96	6.40	-12.57
B2	50.20	-62.40	-3.13	6.40	-20.04
B3	56.93	-62.40	-3.55	6.40	-22.73
SUM =			**-8.65**		**-55.33**

HORIZONTAL:

Force = B(h) = (62.4-Ka*62.4)H^2/2, acts at HD/3:

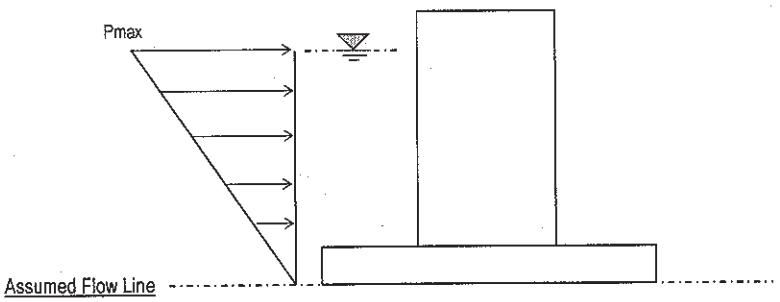
AREA #	Force (Kips)	Arm (Feet)	Moment (Ft x K)
STATIC	0.00	4.22	0.00
SEISMIC	0.00	4.22	0.00
SUM =	**0.00**		**0.00**

Stream Flow Pressure

Note: The flow line is conservatively assumed to act at the bottom of the footing

Pmax:	0.1960	ksf
APPLIED:	N	

LOAD	HORIZONTAL		
	FORCE (Kips)	ARM (Feet)	MOM (Ft x K)
SF	0.00	8.44	0.00



Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Longitudinal Section	**Date:**	September 28, 2011

Service Load Group Summary - GROUP I

GROUP I: DL+LL+E+B+SF

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	D1	31.48	150.00	4.72	6.40	30.21			
	D2	75.08	150.00	11.26	6.40	72.05			
	D3		150.00	0.00	0.00	0.00			
	D4		150.00	0.00	0.00	0.00			
	D5		150.00	0.00	0.00	0.00			
	Subtotal Concrete			**15.98**	**6.40**	**102.26**			
	E TOT	56.93	118.00	6.72	6.40	42.98			
	E2		118.00	0.00	10.83	0.00			
	E3		118.00	0.00	6.40	0.00			
	E4		118.00	0.00	6.40	0.00			
	Subtotal Earth			**6.72**	**6.40**	**42.98**			
	Superstructure			**19.26**	**6.40**	**123.20**			
	TOTAL DL			**41.96**		**268.44**			
LL	**Superstructure**			13.12	6.40	83.94			
	TOTAL LL			**13.12**		**83.94**			
E	Pa(v) =			0.00	0.00	0.00			
	Pa(h) =						1.52	2.92	4.43
	Surch.	0.00	118.00	0.00	0.00	0.00			
	TOTAL E			**0.00**		**0.00**	**1.52**	**2.92**	**4.43**
B	B1(v) =			-1.96	6.40	-12.57			
	B2(v) =			-3.13	6.40	-20.04			
	B3(v) =			-3.55	6.40	-22.73			
	B(h) =						0.00	4.22	0.00
	TOTAL B			**-8.65**	**6.40**	**-55.33**	**0.00**	**4.22**	**0.00**
SF	**TOTAL SF**						**0.00**	8.44	**0.00**
SUM				**46.43**		**297.05**	**1.52**		**4.43**

Stability

	Resisting Moment (Ft x K)	Overturn Moment (Ft x K)	Vertical Force (Kips)	Horiz Force (Kips)
			4.72	
			10.32	
DL1 =	96.26	0.00	15.05	0.00
DL2 =	39.39	0.00	6.16	0.00
DL3 =	112.94	0.00	17.65	0.00
DL =	248.59	0.00	38.86	0.00
LL =	76.94	0.00	12.03	0.00
E =	0.00	4.43	0.00	1.52
B =	-50.72	0.00	-7.93	0.00
SF =	0.00	0.00	0.00	0.00
GROUP I =	274.81	4.43	42.96	1.52

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Longitudinal Section	**Date:**	September 28, 2011

Service Load Group Summary - GROUP II & III

GROUP II: DL+E+B+W+SF

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	**TOTAL DL**			**41.96**		**268.44**			
E	**TOTAL E**			**0.00**		**0.00**	**1.52**		**4.43**
B	**TOTAL B**			**-8.65**		**-55.33**	**0.00**		**0.00**
W	Superstructure			0.00		0.00	0.29	13.33	3.91
	TOTAL W			**0.00**		**0.00**	**0.29**		**3.91**
SF	**TOTAL SF**						**0.00**	8.44	**0.00**
SUM				**33.31**		**213.11**	**1.81**		**8.34**

Stability

	Resisting Moment (Ft x K)	Overturn Moment (Ft x K)	Vertical Force (Kips)	Horiz Force (Kips)
DL =	248.59	0.00	38.86	0.00
E =	0.00	4.43	0.00	1.52
B =	-50.72	0.00	-7.93	0.00
W =	0.00	3.59	0.00	0.27
SF =	0.00	0.00	0.00	0.00
GROUP II =	197.87	8.02	30.93	1.79

GROUP III: DL+LL+E+B+0.3*W+WL+LF+SF

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	**TOTAL DL**			**41.96**		**268.44**			
LL	**TOTAL LL**			**13.12**		**83.94**			
E	**TOTAL E**			**0.00**		**0.00**	**1.52**		**4.43**
B	**TOTAL B**			**-8.65**		**-55.33**	**0.00**		**0.00**
W	**TOTAL W**			**0.00**		**0.00**	**0.29**		**3.91**
WL	Superstructure						0.14	29.16	3.98
	TOTAL WL						**0.14**		**3.98**
LF	Superstructure						0.23	29.16	6.83
	TOTAL LF						**0.23**		**6.83**
SF	**TOTAL SF**						**0.00**	8.44	**0.00**
SUM				**46.43**		**297.05**	**1.98**		**16.41**

Stability

	Resisting Moment (Ft x K)	Overturn Moment (Ft x K)	Vertical Force (Kips)	Horiz Force (Kips)
DL =	248.59	0.00	38.86	0.00
LL =	76.94	0.00	12.03	0.00
E =	0.00	4.43	0.00	1.52
B =	-50.72	0.00	-7.93	0.00
W =	0.00	3.59	0.00	0.27
WL =	0.00	3.64	0.00	0.12
LF =	0.00	6.26	0.00	0.21
SF =	0.00	0.00	0.00	0.00
GROUP III =	274.81	15.41	42.96	1.94

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Longitudinal Section	**Date:**	September 28, 2011

Service Load Group Summary - GROUP IV, V & VI

GROUP IV: GROUP I + T

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
TOTAL GROUP I				**46.43**		**297.05**	**1.52**		**4.43**
T	Superstructure						0.00	17.72	0.00
	TOTAL T						**0.00**		**0.00**
SUM				**46.43**		**297.05**	**1.52**		**4.43**

	Stability Resisting Moment (Ft x K)	Stability Overturn Moment (Ft x K)	Stability Vertical Force (Kips)	Stability Horiz Force (Kips)
GROUP 1 =	274.81	4.43	42.96	1.52
T =	0.00	0.00	0.00	0.00
GROUP IV =	274.81	4.43	42.96	1.52

GROUP V: GROUP II + T

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
TOTAL GROUP II				**33.31**		**213.11**	**1.81**		**8.34**
T	Superstructure						0.00	17.72	0.00
	TOTAL T						**0.00**		**0.00**
SUM				**33.31**		**213.11**	**1.81**		**8.34**

	Stability Resisting Moment (Ft x K)	Stability Overturn Moment (Ft x K)	Stability Vertical Force (Kips)	Stability Horiz Force (Kips)
GROUP II =	197.87	8.02	30.93	1.79
T =	0.00	0.00	0.00	0.00
GROUP V =	197.87	8.02	30.93	1.79

GROUP VI: GROUP III + T

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
TOTAL GROUP III				**46.43**		**297.05**	**1.98**		**16.41**
T	Superstructure						0.00	17.72	0.00
	TOTAL T						**0.00**		**0.00**
SUM				**46.43**		**297.05**	**1.98**		**16.41**

	Stability Resisting Moment (Ft x K)	Stability Overturn Moment (Ft x K)	Stability Vertical Force (Kips)	Stability Horiz Force (Kips)
GROUP III =	274.81	15.41	42.96	1.94
T =	0.00	0.00	0.00	0.00
GROUP VI =	274.81	15.41	42.96	1.94

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Longitudinal Section	**Date:**	September 28, 2011

Service Load Group Summary - GROUP VII & I (CONSTRUCTION)

GROUP VII: DL+E+B+EQ+SF

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	**TOTAL DL**			**41.96**		**268.44**			
E	**TOTAL E**			The earth pressure effects are included in EQ load.					
B	**TOTAL B**			**-8.65**		**-55.33**	**0.00**		**0.00**
EQ	Pae(v)			0.00	0.00	0.00			
	Pae(h)						1.79	4.38	7.85
	Fwi						1.93	9.00	17.36
	Superstructure						4.50	21.22	95.51
	TOTAL E			**0.00**		**0.00**	**8.22**		**120.72**
SF	**TOTAL SF**						**0.00**	8.44	**0.00**
SUM				**33.31**		**213.11**	**8.22**		**120.72**

Stability

	Resisting Moment (Ft x K)	Overturn Moment (Ft x K)	Vertical Force (Kips)	Horiz Force (Kips)
DL =	248.59	0.00	38.86	0.00
E =	0.00	0.00	0.00	0.00
B =	-50.72	0.00	-7.93	0.00
EQ =	0.00	120.72	0.00	8.22
SF =	0.00	0.00	0.00	0.00
GROUP VII =	197.87	120.72	30.93	8.22

GROUP I: DL+E - DURING CONSTRUCTION

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	Subtotal Concrete			15.98		102.26			
	Subtotal Earth			6.72		42.98			
	TOTAL DL			**22.70**		**145.24**			
E	Pa(v) =			0.00	0.00	0.00			
	Pa(h) =						1.52	2.92	4.43
	TOTAL E			**0.00**		**0.00**	**1.52**		**4.43**
SURCH				**0.00**		**0.00**	**0.00**		**0.00**
SUM				**22.70**		**145.24**	**1.52**		**4.43**

Stability

	Resisting Moment (Ft x K)	Overturn Moment (Ft x K)	Vertical Force (Kips)	Horiz Force (Kips)
DL =	248.59	0.00	38.86	0.00
E =	0.00	4.43	0.00	1.52
SC =	0.00	0.00	0.00	0.00
GROUP 1C =	248.59	4.43	38.86	1.52

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Longitudinal Section	**Date:**	September 28, 2011

Check Overturning

CHECK OVERTURNING: (F.S. > 2.0) (F.S>1.5 for Group VII) (REF AASHTO 5.5.5)

GROUP I:

FS(overturning) = SUM Mr / Mo = 274.81 / 4.43 = **62.06** **>2.0 O.K.**

GROUP II:

FS(overturning) = SUM Mr / Mo = 197.87 / 8.02 = **24.68** **>2.0 O.K.**

GROUP III:

FS(overturning) = SUM Mr / Mo = 274.81 / 15.41 = **17.84** **>2.0 O.K.**

GROUP IV:

FS(overturning) = SUM Mr / Mo = 274.81 / 4.43 = **62.06** **>2.0 O.K.**

GROUP V:

FS(overturning) = SUM Mr / Mo = 197.87 / 8.02 = **24.68** **>2.0 O.K.**

GROUP VI:

FS(overturning) = SUM Mr / Mo = 274.81 / 15.41 = **17.84** **>2.0 O.K.**

GROUP VII:

FS(overturning) = SUM Mr / Mo = 197.87 / 120.72 = **1.64** **>1.50 O.K.**

GROUP I - CONSTRUCTION:

FS(overturning) = SUM Mr / Mo = 248.59 / 4.43 = **56.14** **>2.0 O.K.**

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Longitudinal Section	**Date:**	September 28, 2011

Check Sliding

Ignore the passive resistance of the soil since it may get washed away.

Ppass = 0 plf

CHECK SLIDING: (F.S. > 1.5) (F.S. >1.125 for Group VII)

$$F.S.(sliding) = \frac{Ppass + Sum\ V * Tan(phi)}{Sum\ H}$$

GROUP I: FS(sliding) =	0	+	42.96	*	0.500 / 1.52	=	14.16	> 1.50	OK
GROUP II: FS(sliding) =	0	+	30.93	*	0.500 / 1.79	=	8.66	> 1.50	OK
GROUP III: FS(sliding) =	0	+	42.96	*	0.500 / 1.94	=	11.09	> 1.50	OK
GROUP IV: FS(sliding) =	0	+	42.96	*	0.500 / 1.52	=	14.16	> 1.50	OK
GROUP V: FS(sliding) =	0	+	30.93	*	0.500 / 1.79	=	8.66	> 1.50	OK
GROUP VI: FS(sliding) =	0	+	42.96	*	0.500 / 1.94	=	11.09	> 1.50	OK
GROUP VII: FS(sliding) =	0	+	30.93	*	0.500 / 8.22	=	1.88	> 1.125	OK
GROUP I - CONSTRUCTION: FS(sliding) =	0	+	38.86	*	0.500 / 1.52	=	12.81	> 1.50	OK

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Longitudinal Section	**Date:**	September 28, 2011

Check Bearing Pressure

* - indicates the effect of buoyancy has been neglected.

GROUP :	I	II	III	IV	V	VI	VII	I-CON
Q =	42.96	30.93	42.96	42.96	30.93	42.96	30.93	38.86
Bv =	-7.93	-7.93	-7.93	-7.93	-7.93	-7.93	-7.93	
Q* =	50.88	38.86	50.88	50.88	38.86	50.88	38.86	38.86
Mr =	274.81	197.87	274.81	274.81	197.87	274.81	197.87	248.59
Mo =	4.43	8.02	15.41	4.43	8.02	15.41	120.72	4.43
Mnet =	270.38	189.85	259.40	270.38	189.85	259.40	77.15	244.16
Mb =	-50.72	-50.72	-50.72	-50.72	-50.72	-50.72	-50.72	
Mr* =	325.53	248.59	325.53	325.53	248.59	325.53	248.59	248.59
Mnet* =	321.11	240.57	310.13	321.11	240.57	310.13	127.87	244.16
e =	0.10	0.26	0.36	0.10	0.26	0.36	3.90	0.11
e* =	0.09	0.21	0.30	0.09	0.21	0.30	3.11	0.11
B/6 =	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13
qheel =	3.19	2.12	2.79	3.19	2.12	2.79	0.00	2.87
qtoe =	3.52	2.71	3.92	3.52	2.71	3.92	8.27	3.20
qheel* =	3.81	2.74	3.41	3.81	2.74	3.41	0.00	2.87
qtoe* =	4.14	3.33	4.54	4.14	3.33	4.54	7.46	3.20
Allowable =	6.63	8.29	8.29	8.29	9.29	9.29	8.84	6.63
Kern (all) =	2.13	2.13	2.13	2.13	2.13	2.13	4.27	4.27
Bear. Check:	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
Kern Check:	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Longitudinal Section	**Date:**	September 28, 2011

Factored Load Group Summary - GROUP I & II

Per AASHTO Table 3.22.1A, for Load Factor Design, β_E = 1.3

GROUP I: 1.3*(DL+1.67*LL+E+B+SF)

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	**TOTAL DL**			**41.96**		**268.44**			
1.67*LL	**TOTAL LL**			**21.91**		**140.18**			
E	Pa(v) =			0.00	0.00	0.00			
	β_E*Pa(h) =						1.97	3.80	5.76
	Surch.	0.00	118.00	0.00	0.00	0.00			
	TOTAL E			**0.00**		**0.00**	**1.97**		**5.76**
B	**TOTAL B**			**-8.65**		**-55.33**	**0.00**		**0.00**
SF	**TOTAL SF**						**0.00**		**0.00**
SUM				**71.79**		**459.27**	**2.56**		**7.48**

GROUP II: 1.3(DL+E+B+W+SF)

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	**TOTAL DL**			**41.96**		**268.44**			
E	**TOTAL E**			**0.00**		**0.00**	**1.97**		**5.76**
B	**TOTAL B**			**-8.65**		**-55.33**	**0.00**		**0.00**
W	Superstructure						0.29	13.33	3.91
	TOTAL W			**0.00**		**0.00**	**0.29**		**3.91**
SF	**TOTAL SF**						**0.00**		**0.00**
SUM				**43.30**		**277.04**	**2.94**		**12.57**

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Longitudinal Section	**Date:**	September 28, 2011

Factored Load Group Summary - GROUP III & IV

GROUP III: 1.3(DL+LL+E+B+0.3*W+WL+LF+SF)

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	**TOTAL DL**			**41.96**		**268.44**	**0.00**		**0.00**
LL	**TOTAL LL**			**13.12**		**83.94**	**0.00**		**0.00**
E	**TOTAL E**			**0.00**		**0.00**	**1.97**		**5.76**
B	**TOTAL B**			**-8.65**		**-55.33**	**0.00**		**0.00**
W	**TOTAL W**			**0.00**		**0.00**	**0.29**		**3.91**
WL	Superstructure						0.14	29.16	3.98
	TOTAL WL						**0.14**	**0.00**	**3.98**
LF	Superstructure						0.23	29.16	6.83
	TOTAL LF						**0.23**	**0.00**	**6.83**
SF	**TOTAL SF**						**0.00**		**0.00**
SUM				**60.36**		**386.16**	**3.16**		**23.05**

GROUP IV: 1.3*(DL+LL+E+B+T+SF)

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	**TOTAL DL**			**41.96**		**268.44**			
LL	**TOTAL LL**			**13.12**		**83.94**			
E	Pa(v) =			0.00		0.00			
	1.3*Pa(h) =						1.97	3.80	5.76
	Surch.	0.00	118.00	0.00	0.00	0.00			
	TOTAL E			**0.00**		**0.00**	**1.97**		**5.76**
B	**TOTAL B**			**-8.65**		**-55.33**	**0.00**		**0.00**
T	Superstructure						0.00	17.72	0.00
	TOTAL T						**0.00**		**0.00**
SF	**TOTAL SF**						**0.00**		**0.00**
SUM				**60.36**		**386.16**	**2.56**		**7.48**

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Longitudinal Section	**Date:**	September 28, 2011

Factored Load Group Summary - GROUP V, VI & VII

GROUP V: GROUP II * (1.25/1.30) + 1.25*T

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
TOTAL GROUP II				**43.30**		**277.04**	**2.94**		**12.57**
T	Superstructure						0.00	17.72	0.00
	TOTAL T						**0.00**		**0.00**
SUM				**41.64**	**0.00**	**266.39**	**2.83**	**0.00**	**12.09**

GROUP VI: GROUP III * (1.25/1.30) + 1.25*T

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
TOTAL GROUP III				**60.36**		**386.16**	**3.16**		**23.05**
T	Superstructure						0.00	17.72	0.00
	TOTAL T						**0.00**		**0.00**
SUM				**58.04**	**0.00**	**371.31**	**3.04**	**0.00**	**22.17**

GROUP VII: 1.3*(DL+E+B+EQ+SF)

	Area #	Volume (CF)	Gamma (#/CF)	Vertical Force (Kips)	Arm (Feet)	Resisting Moment (Ft x K)	Horiz Force (Kips)	Arm (Feet)	Overturn Moment (Ft x K)
DL	**TOTAL DL**			**41.96**		**268.44**			
E	**TOTAL E**			The earth pressure effects are included in EQ load.					
B	**TOTAL B**			**-8.65**		**-55.33**	**0.00**		**0.00**
EQ	**TOTAL EQ**			**0.00**		**0.00**	**8.22**		**120.72**
SF	**TOTAL SF**						**0.00**		**0.00**
SUM				**43.30**		**277.04**	**10.69**		**156.93**

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Longitudinal Section	**Date:**	September 28, 2011

Factored Toe Moment Calculation

* - indicates the effect of buoyancy has been neglected.

GROUP :	I	II	III	IV	V	VI	VII
Q =	71.79	43.30	60.36	60.36	41.64	58.04	43.30
Bv =	-11.24	-11.24	-11.24	-11.24	-10.81	-10.81	-11.24
Q* =	83.03	54.55	71.60	71.60	52.45	68.85	54.55
Mr =	459.27	277.04	386.16	386.16	266.39	371.31	277.04
Mo =	7.48	12.57	23.05	7.48	12.09	22.17	156.93
Mnet =	451.79	264.47	363.11	378.68	254.30	349.14	120.11
Mb =	-71.93	-71.93	-71.93	-71.93	-69.17	-69.17	-71.93
Mr* =	531.21	348.98	458.10	458.10	335.55	440.48	348.98
Mnet* =	523.72	336.40	435.04	450.61	323.46	418.31	192.04
e =	0.10	0.29	0.38	0.12	0.29	0.38	3.62
e* =	0.09	0.23	0.32	0.10	0.23	0.32	2.88
B/6 =	2.13	2.13	2.13	2.13	2.13	2.13	2.13
qheel =	4.89	2.68	3.55	4.07	2.58	3.41	0.00
qtoe =	5.39	3.52	5.10	4.58	3.39	4.90	9.54
B' =	12.80	12.80	12.80	12.80	12.80	12.80	8.32
q2 =	5.24	3.26	4.62	4.42	3.14	4.44	5.03
Mtoe =	41.41	26.65	38.28	35.06	25.62	36.81	62.28
Vtoe =	20.93	13.37	19.14	17.71	12.85	18.40	28.68
qheel* =	5.70	3.49	4.36	4.88	3.35	4.19	0.00
qtoe* =	6.20	4.33	5.90	5.38	4.16	5.68	9.18
B'* =	12.80	12.80	12.80	12.80	12.80	12.80	10.56
q2* =	6.05	4.07	5.43	5.23	3.91	5.22	5.76
Mtoe* =	47.65	32.89	44.53	41.30	31.62	42.81	62.30
Vtoe* =	24.10	16.54	22.31	20.88	15.90	21.45	29.41

Max. Toe Moment =	**62.304**	kip*ft
Max. Toe Shear =	**29.405**	kips

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Longitudinal Section	**Date:**	September 28, 2011

Design Toe Reinforcement

DESIGN FOOTING TOE REINF (BOTTOM BARS):
(REF: AASHTO: 8.16.1.2, 8.16.3.2, 8.17.1)

Mu =	62.30	kip*ft
ASSUME COVER =	3.00	in.
HEIGHT FOOTING: h =	2.46	ft
phi =	0.90	
f'c =	4.00	ksi
fy =	60.00	ksi
d =	26.15	in. = h - cover - 1/2db(main) -db(stirup)
Sx =	1743.75	in^3
fcr =	474.34	psi
1.2*Mcr =	82.71	kip ft
a = Asfy/0.85f'cb =	1.11	in.
phi*Mn =	86.89	= phi[Asfy(d-a/2)]/12 kip ft.
As required for Mu:	0.5375	in^2
Min As (#4@18"):	0.1333	in^2
As(req'd) =	0.54 < 0.75	OK

USE # 6.00 @ 7.00 IN

	Bar #	As(bar)	db	Spg (in)	As prov (in^2)
Stirrup	0.00	0.00	0.00		
Flexural	6.00	0.44	0.75	7.00	0.75

CHECK SHEAR CAPACITY OF CONCRETE: (AASHTO 8.16.6.2)

Vc = 2*f'c^.5*bw*d

f'c =	4.00	
d =	26.15	
bw =	12.00	(per linear ft of heel)
phi =	0.85	
Vu =	29.41	kips
PHI*Vc =	33.74	O.K.

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Longitudinal Section	**Date:**	September 28, 2011

Factored Heel Moment Calculation

GROUP	I	II	III	IV	V	VI	VII
E3 =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
arm = BE/2 =	1.97	1.97	1.97	1.97	1.97	1.97	1.97
M3 = E3*arm =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Surcharge=	0.00	0.00	0.00	0.00	0.00	0.00	0.00
arm = BE/2 =	1.97	1.97	1.97	1.97	1.97	1.97	1.97
MSUR = SUR*arm =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HEEL CONC. =	1.89	1.89	1.89	1.89	1.89	1.89	1.89
arm = BE/2 =	1.97	1.97	1.97	1.97	1.97	1.97	1.97
Mconc. =	3.72	3.72	3.72	3.72	3.72	3.72	3.72
Pa(v) =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
arm = BE	3.94	3.94	3.94	3.94	3.94	3.94	3.94
Mpv =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vu =	1.89	1.89	1.89	1.89	1.89	1.89	1.89
Mheel(top) =	3.72	3.72	3.72	3.72	3.72	3.72	3.72

Max. Heel Moment =	**3.719**	kip*ft
Max. Heel Shear =	**1.889**	kips

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Longitudinal Section	**Date:**	September 28, 2011

Design Heel Reinforcement

DESIGN FOOTING HEEL REINF (TOP BARS):

Mu =	3.72	kip*ft
ASSUME COVER =	2.00	in.
HEIGHT FOOTING: h =	2.46	ft
phi =	0.90	
f'c =	4.00	ksi
fy =	60.00	ksi
d =	27.15	in. = h - cover - 1/2db(main) -db(stirup)
Sx =	1743.75	in^3
fcr =	474.34	psi
1.2*Mcr =	82.71	kip ft
a = Asfy/0.85f'cb =	0.65	in.
phi*Mn =	53.12	= phi[Asfy(d-a/2)]/12 kip ft.
As required for Mu:	0.0305	in^2
Min As (#4@18"):	0.1333	in^2
As(req.) =	0.13 < 0.44	OK

USE # 6.00 @ 12.00 IN

	Bar #	As(bar)	db	Spg (in)	As prov (in^2)
Stirrup	0.00	0.00	0.00		
Flexural	6.00	0.44	0.75	12.00	0.44

CHECK SHEAR CAPACITY OF CONCRETE: (AASHTO 8.16.6.2)

Vc = 2*f'c^.5*bw*d

f'c =	4.00	
d =	27.15	
bw =	12.00	(per linear ft of heel)
phi =	0.85	
Vu =	1.89	kips
PHI*Vc =	35.03	O.K.

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Longitudinal Section	**Date:**	September 28, 2011

Compute the Lateral Loads on the Stem at Various Heights

Check the stem reinforcement at various locations along the stem and at the base of the backwall.

Height of Stem plus Backwall, h = H - F =	15.26	ft
Height of Backwall =	0.00	ft
Ftg Dowel Lap Length:	6.00	ft
Width of Stem at the Base:	4.92	ft
Width of Backwall:	0.00	ft
Width of Batter:	0.00	ft

Height of h	Height from top	Width Batter	Width conc	
1.00	15.26	0.00	4.92	<=== This section is at the bottom of the stem.
0.61	9.26	0.00	4.92	<=== This section is at the top of the footing dowel.
0.30	4.63	0.00	4.92	<=== This section is halfway in between top of footing dowel and top of stem.

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Longitudinal Section	**Date:**	September 28, 2011

Compute the Lateral Loads on the Stem at Various Heights Continued

CALCULATE EARTH PRESSURES AT EACH HEIGHT:

h = 15.26

hi	Kai	Gamma	Fi	Pi(h)	ARM	M
0	0.33	118.000	0.00	0.000	15.26	0.00
6.2992126	0.33	118.000	0.00	0.000	3.15	0.00
6.2992126	0.33	118.000	0.25	0.750	2.10	1.57
SUM =				**0.75**	**2.10**	**1.57**

h = 9.26

hi	Kai	Gamma	Fi	Pi(h)	ARM	M
0	0.33	118.000	0.00	0.000	9.26	0.00
6.2992126	0.33	118.000	0.00	0.000	3.15	0.00
6.2992126	0.33	118.000	0.25	0.750	2.10	1.57
SUM =				**0.75**	**2.10**	**1.57**

h = 4.63

hi	Kai	Gamma	Fi	Pi(h)	ARM	M
0	0.33	118.000	0.00	0.000	4.63	0.00
6.2992126	0.33	118.000	0.00	0.000	3.15	0.00
6.2992126	0.33	118.000	0.25	0.750	2.10	1.57
SUM =				**0.75**	**2.10**	**1.57**

CALCULATE SEISMIC PRESSURES AT EACH HEIGHT:

h = 15.26

hi	Kai	Gamma	Fi	Pae(h)i	ARM	M
0	0.40	118.000	0.00	0.000		
6.2992126	0.40	118.000	0.00	0.000		
6.2992126	0.40	118.000	0.29	0.886		
SUM =				**0.89**	**3.15**	**2.79**

h = 9.26

hi	Kai	Gamma	Fi	Pae(h)i	ARM	M
0	0.40	118.000	0.00	0.000		
6.2992126	0.40	118.000	0.00	0.000		
6.2992126	0.40	118.000	0.29	0.886		
SUM =				**0.89**	**3.15**	**2.79**

h = 4.63

hi	Kai	Gamma	Fi	Pae(h)i	ARM	M
0	0.40	118.000	0.00	0.000		
6.2992126	0.40	118.000	0.00	0.000		
6.2992126	0.40	118.000	0.29	0.886		
SUM =				**0.89**	**3.15**	**2.79**

Intermediate Pier Design

General Information

Project Number:	127-1298-10001-LT0009	**Designed By:**	nav
Description:	USAID - Khost Bridge	**Checked By:**	jz
Structure:	Intermediate Pier - Longitudinal Section	**Date:**	September 28, 2011

Compute the Lateral Loads on the Stem at Various Heights Continued

h =	15.26	W =	4.92				
GROUP:	I	II	III	IV	V	VI	VII
DL =	25.04	25.04	25.04	25.04	24.07	24.07	25.04
arm =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MDL =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LL =	28.48		17.06	17.06		16.40	
arm =	0.00		0.00	0.00		0.00	
MLL =	0.00		0.00	0.00		0.00	
Pa(h) =	1.27	1.27	1.27	1.27	1.27	1.22	
arm =	2.10	2.10	2.10	2.10	2.10	2.10	
MPa(h) =	2.66	2.66	2.66	2.66	2.66	2.56	
B =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
arm =	3.40	3.40	3.40	3.40	3.40	3.40	3.40
MB =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wpier =		0.38	0.11		0.36	0.11	
arm =		10.78	10.78		10.78	10.78	
MW =		4.08	1.22		3.92	1.18	
Wsuper =		0.00	0.00		0.00	0.00	
arm =		20.39	20.39		20.39	20.39	
MW =		0.07	0.02		0.07	0.02	
WL =			0.18			0.17	
arm =			26.70			26.70	
MWL =			4.73			4.55	
LF =			0.30			0.29	
arm =			26.70			26.70	
MLF =			8.13			7.81	
T =				0.00	0.00	0.00	
arm =				15.26	15.26	15.26	
MT =				0.00	0.00	0.00	
Pae(h) =							1.15
arm =							3.15
MPae(h) =							3.63
Fwi =							2.51
arm =							7.63
MFwi =							19.14
EQ =							5.85
arm =							18.76
MEQ =							109.76
Mtotal =	**2.66**	**6.81**	**16.76**	**2.66**	**6.65**	**16.12**	**132.52**
Vtotal =	**1.27**	**1.65**	**1.86**	**1.27**	**1.63**	**1.79**	**9.51**

h =	9.26	W =	4.92				
GROUP:	I	II	III	IV	V	VI	VII
DL =	25.04	25.04	25.04	25.04	24.07	24.07	25.04
arm =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MDL =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LL =	28.48		17.06	17.06		16.40	
arm =	0.00		0.00	0.00		0.00	
MLL =	0.00		0.00	0.00		0.00	
Pa(h) =	1.27	1.27	1.27	1.27	1.22	1.22	
arm =	2.10	2.10	2.10	2.10	2.10	2.10	
MPa(h) =	2.66	2.66	2.66	2.66	2.56	2.56	
B =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
arm =	1.40	1.40	1.40	1.40	1.40	1.40	1.40
MB =	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wpier =		0.38	0.11		0.36	0.11	
arm =		4.78	4.78		4.78	4.78	
MW =		1.81	0.54		1.74	0.52	
Wsuper =		0.00	0.00		0.00	0.00	
arm =		14.39	14.39		14.39	14.39	
MW =		0.05	0.02		0.05	0.01	
WL =			0.18			0.17	
arm =			20.70			20.70	
MWL =			3.67			3.53	
LF =			0.30			0.29	
arm =			20.70			20.70	
MLF =			6.30			6.06	
T =				0.00	0.00	0.00	
arm =				9.26	9.26	9.26	
MT =				0.00	0.00	0.00	
Pae(h) =							1.15
arm =							3.15
MPae(h) =							3.63
Fwi =							1.52
arm =							4.63
MFwi =							7.04
EQ =							5.85
arm =							12.76
MEQ =							74.65
Mtotal =	**2.66**	**4.52**	**13.19**	**2.66**	**4.35**	**12.68**	**85.32**
Vtotal =	**1.27**	**1.65**	**1.86**	**1.27**	**1.59**	**1.79**	**8.53**

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BRIDGE SEAT DESIGN CHECK

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Khost Min Bridge Seat Width

Minimum N Value For SPC B (AASHTO Div IA 6.3.1)

$$N = (203 + 1.67L + 6.66H)(1 + .000125S^2)$$

L = Length of Deck between joints

H = For Abutment, Height of Columns supporting the bridge deck to the next expansion joint

H = Height of column

Minimum N for Abutments

$$N = 203 + 1.67(15) + 6.66(7.1)(1)$$

$$N = 275.336 \approx 11'' \approx$$

Minimum N for Pier

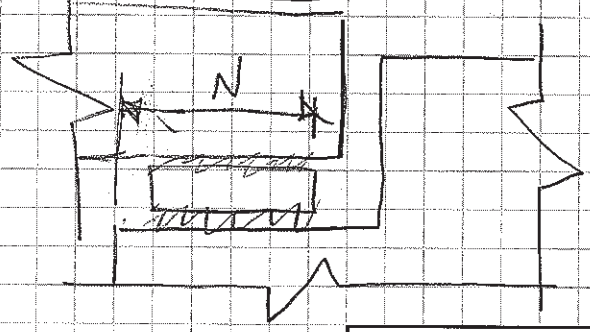
$$N = 203 + 1.67(15) + 6.66(5.4)(1)$$

$$N = 264.014 \approx 11''$$

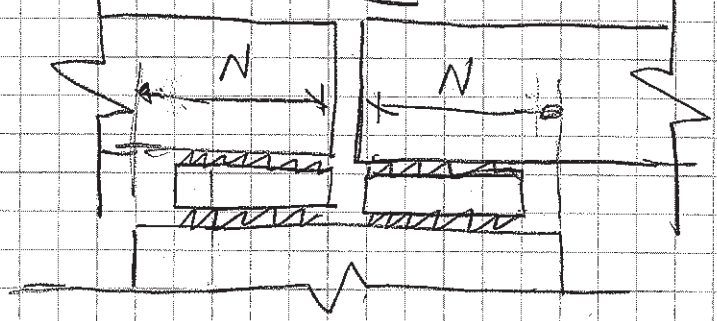
Design Bearing Dia = 450 ≈ 18" > 11"

Bearing OKay

Abutment



Pier



TETRA TECH
One Grant Street
Framingham, MA 01701-9005
(508) 903-2000

JOB Khost – Sagai Bridge
SHEET NO. ____ OF ____
CALCULATED BY EZ, PK DATE 9/21/11
CHECKED BY APL DATE 9/21
SCALE ____

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CULVERT DESIGN

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Concrete Frame Loads - Vehicular

General Information

Project Number:	127-1298-10001 Khost Bridge	**Designed By:**	EWK
Description:	LT00009 - Khost Bridge	**Checked By:**	nav
Structure:	RIGID CONCRETE FRAME	**Date:**	September 16, 2011

References:

- AASHTO Standard Specification for Highways and Bridges, 17th Edition, 2002
- ACI 318-05 Building Code Requirements for Structural Concrete, 2005
- International Building Code, 2006

Notes:

1. SINCE SLIDING AND UPLIFT DO NOT CONTROL THE DESIGN, THE EFFECTS OF BOUYANCY HAVE NOT BEEN INCLUDED IN THE DESIGN. THIS IS CONSERVATIVE FOR THE EFFECTS OF LATERAL EARTH PRESSURE AND BEARING PRESSURE.
2. LIVE LOAD SURCHARGE HAS NOT BEEN INCLUDED.
3. THE EFFECTS OF WIND, WIND ON LIVE LOAD, LONGITUDINAL FORCE HAVE NOT BEEN INCLUDED, AS THEIR IMPACT ON THIS TYPE OF STRUCTURE ARE NEGLIGIBLE.

General Design Parameters

GEOMETRY:

HORIZ CLEAR SPAN, W: (interior)	5.58	ft	1.70	m
VERT CLEAR SPAN, V: (interior)	6.33	ft	1.93	m
TOP SLAB THICKNESS (ts):	0.66	ft	0.20	m
WALL THICKNESS (tw):	0.66	ft	0.20	m
DESIGN FRAME WIDTH, bw:	0.98	ft	0.30	m
BASE SLAB WIDTH, B: (exterior)	6.89	ft	2.10	m
BASE SLAB HEIGHT, F:	0.98	ft	0.30	m
BARRIER HEIGHT, hb:	3.44	ft	1.05	m
AVG BARRIER WIDTH, wb:	1.97	ft	0.60	m
TOTAL BRIDGE WIDTH:	76.72	ft	23.39	m
AVG SOIL HEIGHT ABOVE CULVERT	8.27	ft	2.52	m
AVG SOIL HEIGHT ABOVE BOT SLAB	0.98	ft	0.30	m
TOP SLAB LENGTH (FOR STAAD):	6.234	ft		
WALL HEIGHT (FOR STAAD):	7.152	ft		

GEOTECHNICAL INFORMATION:

WEIGHT OF SOIL BACKFILL:	118.00	Lbs/CF
ALLOWABLE BEARING CAPACITY:	3.60	ksf
WALL ON LEDGE:	N	(Y OR N)
WALL ON PILES:	N	(Y OR N)

CUBIC WEIGHT CONCRETE:	150.00	Lbs/CF
COMP. STRENGTH OF CONC. = F'c:	4.00	ksi
TENSILE STRENGTH OF REBAR = Fy:	60.00	ksi

Concrete Frame Loads - Vehicular

General Information

Project Number:	127-1298-10001 Khost Bridge	**Designed By:**	EWK
Description:	LT00009 - Khost Bridge	**Checked By:**	nav
Structure:	RIGID CONCRETE FRAME	**Date:**	September 16, 2011

LOAD CASE 1 - DL

TOP SLAB WEIGHT:	Selfweight ✓	==> H=	0.656	ft,	W=	0.984	ft
WALL WEIGHT:	Selfweight ✓	==> H=	0.656	ft,	W=	0.984	ft

BARRIER WEIGHT:	1.017	klf
BARRIER DIST WIDTH = 2*fill height	16.54	ft ✓
BARRIER WEIGHT FOR STAAD:	0.062	klf ✓

LOAD CASE 2 - LL

Based on AASHTO Appendix A, Truck loading governs over lane loading.

DESIGN LL TRUCK:	HS25	✓
Wheel Load, P:	20.00	kips
IMPACT = 1+50/(L+125), Max = 1.30:	1.000	

Distribution of LL to Concrete Slabs per AASHTO 3.24:

Standard Tire Contact Area	0.830	ft	x	1.670	ft
Depth of Soil Above Culvert	8.268	ft			
Design Tire Contact Area	14.469	ft	x	14.469	ft
Axle/ Wheel Spacing	14.000	ft		6.000	ft
Wheels Areas Overlap	YES			YES	
Number of Tires	2.000			2.000	
Design Distributed Contact Area	6.234	ft	x	22.139	ft
Total Contact Area	138.002	sf			
Distributed Vehicle Live Load	0.000	ksf		<== IF FILL IS GREATER THAN 8' THEN LIVE LOAD IS IGNORED ✓	
Distributed Design Live Load (FOR STAAD)	0.000	klf			

Concrete Frame Loads - Vehicular

General Information

Project Number:	127-1298-10001 Khost Bridge	**Designed By:**	EWK
Description:	LT00009 - Khost Bridge	**Checked By:**	nav
Structure:	RIGID CONCRETE FRAME	**Date:**	September 16, 2011

LOAD CASE 3 - EARTH

NOTES:

1. Earth pressure is treated as an entirely horizontal load, which is conservative for wall design.

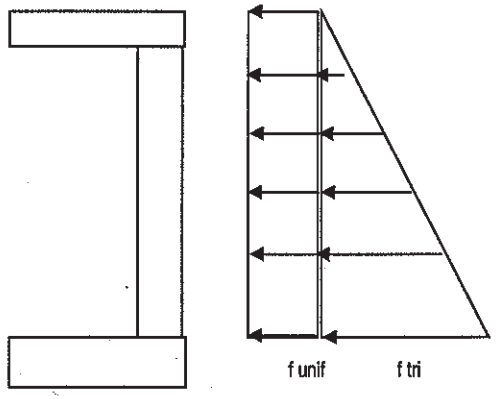
2. Both

Horizontal & Vertical Earth Pressures shall include modification factor of 1.15 maximum per AASHTO 16.6.4.2.1 for LFD load combination only (entered in STAAD).

HORIZONTAL EARTH

Earth Pressure Coeff (based on Geotech Report):

Ko =	0.50
Ka =	0.33
Kp =	3.00



Compute Earth Loads due to At-Rest Pressure:

Fi(h) =(Ko)(Gamma)(hi)

	hi	Ko	Gamma	Fi (klf)
f unif	8.60	0.500	118.00	0.507
f tri	7.15	0.500	118.00	0.422

VERTICAL EARTH

Vertical Earth Pressue on Roof Slab	0.976	klf	<=== Used for STAAD Model.
Vertical Earth Pressure on Base Slab	0.116	klf	<=== Used for STAAD Model.

```
*****************************************************
*                                                   *
*           STAAD.Pro V8i SELECTseries2             *
*           Version  20.07.07.32                    *
*           Proprietary Program of                  *
*           Bentley Systems, Inc.                   *
*           Date=    SEP 16, 2011                   *
*           Time=     9:30:38                       *
*                                                   *
*      USER ID: Tetra Tech Inc.                     *
*****************************************************
```

CHECKED BY: nav 9/16/11

```
     1. STAAD PLANE
INPUT FILE: Frame_HS25 wo EQ.STD
     2. START JOB INFORMATION
     3. ENGINEER DATE 30-AUG-11
     4. JOB NAME KHOST PRT
     5. JOB CLIENT USAID
     6. JOB NO 127-1298-10001
     7. ENGINEER NAME EWK
     8. JOB REV HS25 CULVERT
     9. END JOB INFORMATION
    10. INPUT WIDTH 79
    11. ******************************************
    12. UNIT FEET KIP
    13. JOINT COORDINATES
    14. 1 0 0; 2 0 7.15 0; 3 6.232 7.1504 0; 4 6.232 0 0; 5 4.9856 0 0; 6 3.7392 0 0
    15. 7 2.4928 0 0; 8 1.2464 0 0
    16. MEMBER INCIDENCES
    17. 1 1 2; 2 2 3; 3 4 3; 4 1 8; 5 5 6; 6 6 7; 7 7 8; 8 5 4
    18. ****************************************
    19. DEFINE MATERIAL START
    20. ISOTROPIC CONCRETE
    21. E 453600
    22. POISSON 0.17
    23. DENSITY 0.14999
    24. ALPHA 5.5E-006
    25. DAMP 0.05
    26. END DEFINE MATERIAL
    27. ************************************
    28. MEMBER PROPERTY AMERICAN
    29. 4 TO 8 PRIS YD 0.984 ZD 0.984
    30. 1 TO 3 PRIS YD 0.66 ZD 0.984
    31. ************************************
    32. CONSTANTS
    33. MATERIAL CONCRETE ALL
    34. ********************************
    35. SUPPORTS
    36. 1 4 TO 8 ELASTIC FOOTING 0.912 0.998 DIRECT Y SUBGRADE 380160
    37. ******************************
    38. LOAD 1 LOADTYPE DEAD  TITLE DL
    39. SELFWEIGHT Y -1
    40. MEMBER LOAD
```

```
41. 2 UNI GY -0.062
42. **************************
43. LOAD 2 LOADTYPE LIVE  TITLE LL  *LIVE LOAD NOT CONSIDERED DUE TO FILL HEIGHT*
44. *MEMBER LOAD
45. *2 UNI GY -1E-005
46. LOAD 4 LOADTYPE SOIL  TITLE E
47. MEMBER LOAD
48. 3 TRAP GX -0.422 0
49. 1 UNI GX 0.507
50. 1 TRAP GX 0.422 0
51. 3 UNI GX -0.507
52. 2 UNI GY -0.976
53. 4 TO 8 UNI GY -0.116
54. **************************
55. LOAD COMB 20 GROUP X - DL+LL+E-ASD
56. 1 1.0 4 1.0
57. LOAD COMB 21 GROUP X - DL+LL+0.5E-ASD
58. 1 1.0 4 0.5
59. *SERVICE LOAD FACTOR APPLIED*
60. LOAD COMB 22 GROUP VII - 1.3DL+2.171LL+1.495E-LFD
61. 1 1.3 4 1.495
62. PERFORM ANALYSIS


        P R O B L E M   S T A T I S T I C S
        -----------------------------------

 NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =     8/     8/     6

       SOLVER USED IS THE IN-CORE ADVANCED SOLVER

 TOTAL PRIMARY LOAD CASES =    3, TOTAL DEGREES OF FREEDOM =     18


63. FINISH
```

Concrete Frame Servicability - Vehicular

General Information

Project Number:	127-1298-10001 Khost Bridge	**Designed By:**	EWK
Description:	LT00009 - Khost Bridge	**Checked By:**	nov
Structure:	RIGID CONCRETE FRAME	**Date:**	September 16, 2011

References:

- AASHTO Standard Specification for Highways and Bridges, 17th Edition, 2002
- ACI 318-05 Building Code Requirements for Structural Concrete, 2005
- International Building Code, 2006

Notes:

1. SEE ATTACHED STAAD OUTPUT FOR REACTIONS

Check Bearing Pressure

FOOTING WIDTH:	1.240	ft ✓
ALLOWABLE BEARING PRESSURE (Non-EQ):	3.600	ksf ✓
ALLOWABLE BEARING PRESSURE (EQ):	4.788	ksf ✓

Node	Load Combination	Fy (kip) Vert	q = Fy / B	OK?
1	20 DL+LL+E-ASD	2.202 ✓	1.78	OK
	21 DL+LL+0.5E-ASD	1.762 ✓	1.42	OK
5	20 DL+LL+E-ASD	2.359 ✓	1.90	OK
	21 DL+LL+0.5E-ASD	1.278 ✓	1.03	OK
6	20 DL+LL+E-ASD	0.488 ✓	0.39	OK
	21 DL+LL+0.5E-ASD	0.307 ✓	0.25	OK
7	20 DL+LL+E-ASD	0.488 ✓	0.39	OK
	21 DL+LL+0.5E-ASD	0.307 ✓	0.25	OK
8	20 DL+LL+E-ASD	2.359 ✓	1.90	OK
	21 DL+LL+0.5E-ASD	1.278 ✓	1.03	OK
4	20 DL+LL+E-ASD	2.202 ✓	1.78	OK
	21 DL+LL+0.5E-ASD	1.761 ✓	1.42	OK
Overall Bearing	20 DL+LL+E-ASD	10.098	1.47	OK
	21 DL+LL+0.5E-ASD	6.693	0.97	OK

Job Information

	Engineer	Checked	Approved
Name:	EWK	nav	
Date:	30-Aug-11	9/16/11	

Structure Type	PLANE FRAME

Number of Nodes	8	Highest Node	8
Number of Elements	8	Highest Beam	8

Number of Basic Load Cases	3
Number of Combination Load Cases	3

Included in this printout are data for:

All	The Whole Structure

Included in this printout are results for load cases:

Type	L/C	Name
Combination	20	GROUP X - DL+LL+E-ASD
Combination	21	GROUP X - DL+LL+0.5E-ASD

Reactions

		Horizontal	Vertical	Horizontal	Moment		
Node	L/C	FX (kip)	FY (kip)	FZ (kip)	MX (kip-in)	MY (kip-in)	MZ (kip-in)
1	20:GROUP X -	-2.728	2.202	0.000	0.000	0.000	0.000
	21:GROUP X -	-1.332	1.762	0.000	0.000	0.000	0.000
4	20:GROUP X -	2.728	2.201	0.000	0.000	0.000	0.000
	21:GROUP X -	1.332	1.761	0.000	0.000	0.000	0.000
5	20:GROUP X -	0.000	2.360	0.000	0.000	0.000	0.000
	21:GROUP X -	0.000	1.278	0.000	0.000	0.000	0.000
6	20:GROUP X -	0.000	0.488	0.000	0.000	0.000	0.000
	21:GROUP X -	0.000	0.307	0.000	0.000	0.000	0.000
7	20:GROUP X -	0.000	0.488	0.000	0.000	0.000	0.000
	21:GROUP X -	0.000	0.307	0.000	0.000	0.000	0.000
8	20:GROUP X -	0.000	2.359	0.000	0.000	0.000	0.000
	21:GROUP X -	0.000	1.278	0.000	0.000	0.000	0.000

Concrete Frame Reinforcement - Vehicular

General Information

Project Number:	127-1298-10001 Khost Bridge	**Designed By:**	EWK
Description:	LT00009 - Khost Bridge	**Checked By:**	nav
Structure:	RIGID CONCRETE FRAME	**Date:**	September 16, 2011

References:

- AASHTO Standard Specification for Highways and Bridges, 17th Edition, 2002
- ACI 318-05 Building Code Requirements for Structural Concrete, 2005
- International Building Code, 2006

Notes:

1. The concrete frame is modeled in STAAD. The design loads are summarized here, and the reinforcement design is performed.

General Design Parameters

Material Properties:

COMP. STRENGTH OF CONC. = F'c:	4.00	ksi ✓
TENSILE STRENGTH OF REBAR = Fy:	60.00	ksi ✓

Design Coefficients:

Φf:	0.90	AASHTO 16.6.4.6 ✓
Φv:	0.85	AASHTO 16.6.4.6 ✓
Φp:	0.70	AASHTO 8.16.4.1 ✓

Concrete Frame Reinforcement - Vehicular

General Information

Project Number:	127-1298-10001 Khost Bridge	**Designed By:**	EWK
Description:	LT00009 - Khost Bridge	**Checked By:**	nav
Structure:	RIGID CONCRETE FRAME	**Date:**	September 16, 2011

Wall Design

Check if Axial Loads need to be considered:

Wall: Axial (Pwl):	6.10	kips	<=====STAAD OUTPUT	
WALL THICKNESS (tw):	7.87	in		
DESIGN FRAME WIDTH, bw:	11.81	in		
Gross Area of Design Section:	93.00	in^2		
Pu = 0.1*f'c*Ag =	37.20	kips		
Wall: Axial (Pwl):	6.10	kips	<== Biaxial Bending need not be considered per AASHTO 8.16.4.3.	AASHTO EQ 8-37
Wall: Axial Φ(Po)	177.07	kips	Axial Capacity is OK.	AASHTO EQ 8-30

Positive Moment (Interior Reinforcement):

Wall: Pos Moment (Mwpos):	26.94	kip*in
Service Load Wall: Pos Moment	17.88	kip*in
Flexural Bar Size:	#5	
Bar Spacing:	12.00	in
Flexural Bar Area:	0.31	in^2
Flexural Bar Diameter.(BD):	0.63	in
Clear Cover:	2.00	in
Total Rebar Area (As):	0.310	in^2/ft

Mwpos:	26.94	kip*in
WALL THICKNESS (tw):	7.87	in
DESIGN FRAME WIDTH, bw:	11.81	in
Effective Depth of Section (dbm):	5.562	inches

$$a = \frac{A_s F_y}{0.85\ f_c' b}$$

a = 0.463 inches

$$\phi M_n = \phi A_s F_y \left(d - \frac{a}{2} \right)$$

ϕM_n = - 89.223 k*in/ft >Mupos, OK

Concrete Frame Reinforcement - Vehicular

General Information

Project Number:	127-1298-10001 Khost Bridge	**Designed By:**	EWK
Description:	LT00009 - Khost Bridge	**Checked By:**	nav
Structure:	RIGID CONCRETE FRAME	**Date:**	September 16, 2011

Wall Design (cont.)

Check Shear:

Wall: Shear (Vw):	3.58	kips ✓	
Wall Width (Ww):	11.811	inches ✓	
Effective Depth of Section (dw):	5.562	inches ✓	
ØVc=Ø*2*sqrt(f'c)*b*d:	7.06	kips	Vw<ØVc, OK ✓

Crack Control

Max Service Load Stress, fs	22.36		AASHTO EQ 16-19 ✓
β	1.51		
A	48.00		
dc	2.00 ✓		
d	5.56 ✓		
Crack Control Flexural Capacity	33.25	k*in/ft	>Mupos, OK ✓

Concrete Frame Reinforcement - Vehicular

General Information

Project Number:	127-1298-10001 Khost Bridge	**Designed By:**	EWK
Description:	LT00009 - Khost Bridge	**Checked By:**	nav
Structure:	RIGID CONCRETE FRAME	**Date:**	September 16, 2011

Wall Design (cont.)

Negative Moment (Exterior Reinforcement):

Check negative moment region at the corners, where the section is deeper due to the chamfer.

Wall: Shear (Vw):	4.09	kips
Wall: Negative Moment (Mwneg):	60.62	kip*in
Service Load Wall:	41.05	kip*in
Depth of chamfer:	8.00	inches
Effective Depth of Section (dbm):	13.562	inches
Flexural Bar Size:	#5	
Bar Spacing:	12.00	in
Flexural Bar Area:	0.31	in^2
Flexural Bar Diameter.(BD):	0.63	in
Clear Cover:	2.00	in
Total Rebar Area (As):	0.310	in^2/ft

$$a = \frac{A_s F_y}{0.85\ f_c' b}$$

a = 0.463 inches

$$\phi M_n = \phi A_s F_y \left(d - \frac{a}{2} \right)$$

ϕM_n = 223.143 k*in/ft >Muneg, OK

Check negative moment region at the edge of the chamfer.

Wall: Shear (Vw):	3.19	kips
Wall: Negative Moment (Mwneg):	34.27	kip*in
Service Load Wall:	23.36	kip*in
Effective Depth of Section (dbm):	5.562	inches
Flexural Bar Size:	#5	
Bar Spacing:	12.00	in
Flexural Bar Area:	0.31	in^2
Flexural Bar Diameter.(BD):	0.63	in
Clear Cover:	2.00	in
Total Rebar Area (As):	0.310	in^2/ft

a = 0.463 inches

ϕM_n = 89.223 k*in/ft >Muneg, OK

Concrete Frame Reinforcement - Vehicular

General Information

Project Number:	127-1298-10001 Khost Bridge	**Designed By:**	EWK
Description:	LT00009 - Khost Bridge	**Checked By:**	nav
Structure:	RIGID CONCRETE FRAME	**Date:**	September 16, 2011

Wall Design (cont.)

Check Shear:

Vw:	4.091	kips		Vw:	3.194	kips	
Wall Width (Ww):	11.811	inches		Wall Width (Ww):	11.811	inches	
Effective Depth of Section (dw):	13.562	inches		Effective Depth of Section (dw):	5.562	inches	
ØVc=Ø*2*sqrt(f'c)*b*d:	17.22	kips	Vw<ØVc, OK	ØVc=Ø*2*sqrt(f'c)*b*d:	7.06	kips	Vw<ØVc, OK

Shear Friction

u:	1.000		11.6.4.3	u:	1.000		11.6.4.3
phiv:	0.85			phiv:	0.85		
Avf (req'd)=Vu/(Fy*u*phi):	0.08	in^2		Avf (req'd)=Vu/(Fy*u*phi):	0.06	in^2	
As (provided):	0.31	in^2	OK	As (provided):	0.31	in^2	OK

Crack Control				Crack Control			
Max Service Load Stress, fs	27.96		AASHTO EQ 16-19	Max Service Load Stress, fs	22.36		AASHTO EQ 16-19
β	1.21			β	1.51		
A	48.00			A	48.00		
dc	2.00			dc	2.00		
d	13.56			d	5.56		
Crack Control Flexural Capacity	103.987	k*in/ft	Crack Control OK	Crack Control Flexural Capacity	33.254	k*in/ft	Crack Control OK

Concrete Frame Reinforcement - Vehicular

General Information

Project Number:	127-1298-10001 Khost Bridge	**Designed By:**	EWK
Description:	LT00009 - Khost Bridge	**Checked By:**	DGV
Structure:	RIGID CONCRETE FRAME	**Date:**	September 16, 2011

Top Slab Design

Positive Moment (Bottom Reinforcement):

Per AASHTO 3.24.3.2, main reinf for slabs (parallel to traffic) shall be designed for the following moment. Per AASHTO 3.234.4, when slabs have been designed for the following moment, they shall be considered satisfactory in shear and bond.

Span Length, S (AASHTO 3.24.1):	6.23	ft ✓
Truck Load Factor,Tlf	1.25	✓
Mpos = 0.900*S*Tlf:	84.15	kip*in ✓

Flexural Bar Size:	#5	✓
Bar Spacing:	12.00	in ✓
Flexural Bar Area:	0.31	in^2 ✓
Flexural Bar Diameter.(BD):	0.63	in ✓
Clear Cover:	2.00	in ✓
Total Rebar Area (As):	0.310	in^2/ft ✓

TOP SLAB THICKNESS (ts):	7.87	in
DESIGN FRAME WIDTH, bw:	11.81	in
Effective Depth of Section (dbm):	5.562	inches

$$a = \frac{A_s F_y}{0.85 f_c' b}$$

a = 0.463 inches ✓

$$\phi M_n = \phi A_s F_y \left(d - \frac{a}{2} \right)$$

ϕM_n = 89.223 k*in/ft >Mupos, OK ✓

Concrete Frame Reinforcement - Vehicular

General Information

Project Number:	127-1298-10001 Khost Bridge	**Designed By:**	EWK
Description:	LT00009 - Khost Bridge	**Checked By:**	nav
Structure:	RIGID CONCRETE FRAME	**Date:**	September 16, 2011

Top Slab Design (cont.)

Negative Moment (Top Reinforcement):

Check negative moment region at the corners, where the section is deeper due to the chamfer.

Beam: Shear (Vbm):	5.19	kips
Beam: Negative Moment (Mbmneg):	60.62	kip*in
Service Load Beam:	41.05	kip*in
Depth of chamfer:	8.00	inches
Effective Depth of Section (dbm):	13.562	inches
Flexural Bar Size:	#5	
Bar Spacing:	12.00	in
Flexural Bar Area:	0.31	in^2
Flexural Bar Diameter.(BD):	0.63	in
Clear Cover:	2.00	in
Total Rebar Area (As):	0.310	in^2/ft

$$a = \frac{A_s F_y}{0.85 f_c' b}$$

a = 0.463 inches

$$\phi M_n = \phi A_s F_y \left(d - \frac{a}{2} \right)$$

ϕM_n = 223.143 k*in/ft >Muneg, OK

Check negative moment region at the edge of the chamfer.

Beam: Shear (Vbm):	4.09	kips
Beam: Negative Moment (Mbmneg):	23.85	kip*in
Service Load Beam:	16.00	kip*in
Effective Depth of Section (dbm):	5.562	inches
Flexural Bar Size:	#5	
Bar Spacing:	12.00	in
Flexural Bar Area:	0.31	in^2
Flexural Bar Diameter.(BD):	0.63	in
Clear Cover:	2.00	in
Total Rebar Area (As):	0.310	in^2/ft

a = 0.463 inches

ϕM_n = 89.223 k*in/ft >Muneg, OK

Concrete Frame Reinforcement - Vehicular

General Information

Project Number:	127-1298-10001 Khost Bridge	**Designed By:**	EWK
Description:	LT00009 - Khost Bridge	**Checked By:**	nav
Structure:	RIGID CONCRETE FRAME	**Date:**	September 16, 2011

Top Slab Design (cont.)

Check Shear:

Vbm:	5.192	kips ✓		Vbm:	4.093	kips ✓	
Beam Width (Wbm):	11.811	inches ✓		Beam Width (Wbm):	11.811	inches ✓	
Effective Depth of Section (dbm):	13.562	inches		Effective Depth of Section (dbm):	5.562	inches	
ØVc=Ø*2*sqrt(f'c)*b*d:	17.22	kips	**Vbm<ØVc, OK**	ØVc=Ø*2*sqrt(f'c)*b*d:	7.06	kips	**Vbm<ØVc, OK**

Crack Control			Crack Control		
Max Service Load Stress, fs	27.96	AASHTO EQ 16-19	Max Service Load Stress, fs	22.36	AASHTO EQ 16-19
β	1.21		β	1.51	
A	48.00		A	48.00	
dc	2.00		dc	2.00	
d	13.56		d	5.56	
Crack Control Flexural Capacity	103.987 k*in/ft	**Crack Control OK** ✓	Crack Control Flexural Capacity	33.254 k*in/ft	**Crack Control OK** ✓

Concrete Frame Reinforcement - Vehicular

General Information

Project Number:	127-1298-10001 Khost Bridge	**Designed By:**	EWK
Description:	LT00009 - Khost Bridge	**Checked By:**	nav
Structure:	RIGID CONCRETE FRAME	**Date:**	September 16, 2011

Base Slab Design

Bottom Reinforcement:

Vu:	3.52	kips ✓
Mu(+):	50.13	kip*in
Service Load Mu(+):	33.32	kip*in

Check Flexure:

Flexural Bar Size:	#5	
Bar Spacing:	12.00	in
Flexural Bar Area:	0.31	in^2
Flexural Bar Diameter.(BD):	0.63	in
Clear Cover:	3.00	in
Total Rebar Area (As):	0.310	in^2/ft
FTG THICKNESS:	11.81	in
DESIGN FRAME WIDTH, bw:	11.81	in
Effective Depth of Section (dbm):	8.499	inches

$$a = \frac{A_s F_y}{0.85\ f_c' b}$$

a = 0.463 inches

$$\phi M_n = \phi A_s F_y \left(d - \frac{a}{2} \right)$$

ϕM_n = 138.388 k*in/ft >Mu, OK

Check Shear:

ØVc=Ø*2*sqrt(f'c)*b*d:	10.79	kips	V<ØVc, OK

Crack Control

Max Service Load Stress, fs	17.17		AASHTO EQ 16-19
β	1.50		
A	72.00		
dc	3.00		
d	8.50		
Crack Control Flexural Capacity	39.609	k*in/ft	Crack Control, OK

Top Reinforcement:

Vu:	0.48	kips
Mu(-):	2.86	kip*in
Service Load Mu(-):	1.94	kip*in

Check Flexure:

Flexural Bar Size:	#5	
Bar Spacing:	12.00	in
Flexural Bar Area:	0.31	in^2
Flexural Bar Diameter.(BD):	0.63	in
Clear Cover:	2.00	in
Total Rebar Area (As):	0.310	in^2/ft
FTG THICKNESS:	11.81	in
DESIGN FRAME WIDTH, bw:	11.81	in
Effective Depth of Section (dbm):	9.499	inches

a = 0.463 inches

ϕM_n = 155.128 k*in/ft >Mu, OK

Check Shear:

ØVc=Ø*2*sqrt(f'c)*b*d:	12.06	kips	V<ØVc, OK

Crack Control

Max Service Load Stress, fs	26.02		AASHTO EQ 16-19
β	1.30		
A	48.00		
dc	2.00		
d	9.50		
Crack Control Flexural Capacity	67.283	k*in/ft	Crack Control OK

Job Information

	Engineer	Checked	Approved
Name:	EWK		
Date:	30-Aug-11		

Structure Type	PLANE FRAME

Number of Nodes	8	Highest Node	8
Number of Elements	8	Highest Beam	8

Number of Basic Load Cases	3
Number of Combination Load Cases	3

Included in this printout are data for:

All	The Whole Structure

Included in this printout are results for load cases:

Type	L/C	Name
Combination	20	GROUP X - DL+LL+E-ASD
Combination	21	GROUP X - DL+LL+0.5E-ASD
Combination	22	GROUP VII - 1.3DL+2.171LL+1.495E-LFD

Beam Maximum Axial Forces

Distances to maxima are given from beam end A.

Beam	Node A	Length (ft)	L/C		d (ft)	Max Fx (kip)
1	1	7.150	20:GROUP X -	Max -ve	0.000	4.235
				Max +ve		
			21:GROUP X -	Max -ve	0.000	2.714
				Max +ve		
			22:GROUP VII	Max -ve	0.000	6.098
				Max +ve		
2	2	6.232	20:GROUP X -	Max -ve	0.000	2.406
				Max +ve		
			21:GROUP X -	Max -ve	0.000	1.235
				Max +ve		
			22:GROUP VII	Max -ve	0.000	3.584
				Max +ve		
3	4	7.150	20:GROUP X -	Max -ve	0.000	4.234
				Max +ve		
			21:GROUP X -	Max -ve	0.000	2.714
				Max +ve		
			22:GROUP VII	Max -ve	0.000	6.098
				Max +ve		
4	1	1.246	20:GROUP X -	Max -ve	0.000	0.000
				Max +ve	0.000	0.000

Beam Maximum Axial Forces Cont...

Beam	Node A	Length (ft)	L/C		d (ft)	Max Fx (kip)
			21:GROUP X -	Max -ve	0.000	0.000
				Max +ve	0.000	0.000
			22:GROUP VII	Max -ve	0.000	0.000
				Max +ve	0.000	0.000
5	5	1.246	20:GROUP X -	Max -ve	0.000	0.000
				Max +ve	0.000	0.000
			21:GROUP X -	Max -ve	0.000	0.000
				Max +ve	0.000	0.000
			22:GROUP VII	Max -ve	0.000	0.000
				Max +ve	0.000	0.000
6	6	1.246	20:GROUP X -	Max -ve	0.000	0.000
				Max +ve	0.000	0.000
			21:GROUP X -	Max -ve	0.000	0.000
				Max +ve	0.000	0.000
			22:GROUP VII	Max -ve	0.000	0.000
				Max +ve	0.000	0.000
7	7	1.246	20:GROUP X -	Max -ve	0.000	0.000
				Max +ve	0.000	0.000
			21:GROUP X -	Max -ve	0.000	0.000
				Max +ve	0.000	0.000
			22:GROUP VII	Max -ve	0.000	0.000
				Max +ve	0.000	0.000
8	5	1.246	20:GROUP X -	Max -ve	0.000	0.000
				Max +ve	0.000	0.000
			21:GROUP X -	Max -ve	0.000	0.000
				Max +ve	0.000	0.000
			22:GROUP VII	Max -ve	0.000	0.000
				Max +ve	0.000	0.000

Beam Maximum Shear Forces

Distances to maxima are given from beam end A.

Beam	Node A	Length (ft)	L/C		d (ft)	Max Fz (kip)	d (ft)	Max Fy (kip)
1	1	7.150	20:GROUP X -	Max -ve	0.000	0.000	0.000	2.728
				Max +ve	0.000	0.000	7.150	-2.406
			21:GROUP X -	Max -ve	0.000	0.000	0.000	1.332
				Max +ve	0.000	0.000	7.150	-1.235
			22:GROUP VII	Max -ve	0.000	0.000	0.000	4.091
				Max +ve	0.000	0.000	7.150	-3.584
2	2	6.232	20:GROUP X -	Max -ve	0.000	0.000	0.000	3.538
				Max +ve	0.000	0.000	6.232	-3.538
			21:GROUP X -	Max -ve	0.000	0.000	0.000	2.017
				Max +ve	0.000	0.000	6.232	-2.017
			22:GROUP VII	Max -ve	0.000	0.000	0.000	5.192

Beam Maximum Shear Forces Cont...

Beam	Node A	Length (ft)	L/C		d (ft)	Max Fz (kip)	d (ft)	Max Fy (kip)
				Max +ve	0.000	0.000	6.232	-5.192
3	4	7.150	20:GROUP X -	Max -ve	0.000	0.000	7.150	2.406
				Max +ve	0.000	0.000	0.000	-2.728
			21:GROUP X -	Max -ve	0.000	0.000	7.150	1.235
				Max +ve	0.000	0.000	0.000	-1.332
			22:GROUP VII	Max -ve	0.000	0.000	7.150	3.584
				Max +ve	0.000	0.000	0.000	-4.092
4	1	1.246	20:GROUP X -	Max -ve	0.000	0.000		
				Max +ve	0.000	0.000	1.246	-2.358
			21:GROUP X -	Max -ve	0.000	0.000		
				Max +ve	0.000	0.000	1.246	-1.205
			22:GROUP VII	Max -ve	0.000	0.000		
				Max +ve	0.000	0.000	1.246	-3.515
5	5	1.246	20:GROUP X -	Max -ve	0.000	0.000	0.000	0.001
				Max +ve	0.000	0.000	1.246	-0.325
			21:GROUP X -	Max -ve	0.000	0.000	0.000	0.073
				Max +ve	0.000	0.000	1.246	-0.181
			22:GROUP VII	Max -ve	0.000	0.000		
				Max +ve	0.000	0.000	1.246	-0.479
6	6	1.246	20:GROUP X -	Max -ve	0.000	0.000	0.000	0.163
				Max +ve	0.000	0.000	1.246	-0.163
			21:GROUP X -	Max -ve	0.000	0.000	0.000	0.127
				Max +ve	0.000	0.000	1.246	-0.127
			22:GROUP VII	Max -ve	0.000	0.000	0.000	0.226
				Max +ve	0.000	0.000	1.246	-0.226
7	7	1.246	20:GROUP X -	Max -ve	0.000	0.000	0.000	0.325
				Max +ve	0.000	0.000	1.246	-0.001
			21:GROUP X -	Max -ve	0.000	0.000	0.000	0.181
				Max +ve	0.000	0.000	1.246	-0.073
			22:GROUP VII	Max -ve	0.000	0.000	0.000	0.478
				Max +ve	0.000	0.000		
8	5	1.246	20:GROUP X -	Max -ve	0.000	0.000	0.000	2.359
				Max +ve	0.000	0.000		
			21:GROUP X -	Max -ve	0.000	0.000	0.000	1.206
				Max +ve	0.000	0.000		
			22:GROUP VII	Max -ve	0.000	0.000	0.000	3.516
				Max +ve	0.000	0.000		

Beam Maximum Moments

Distances to maxima are given from beam end A.

Beam	Node A	Length (ft)	L/C		d (ft)	Max My (kip-in)	d (ft)	Max Mz (kip-in)
1	1	7.150	20:GROUP X -	Max -ve	0.000	0.000	7.150	41.048
				Max +ve	0.000	0.000	3.575	-17.877
			21:GROUP X -	Max -ve	0.000	0.000	7.150	22.447
				Max +ve	0.000	0.000	2.979	-8.609
			22:GROUP VII	Max -ve	0.000	0.000	7.150	60.617
				Max +ve	0.000	0.000	3.575	-26.941
2	2	6.232	20:GROUP X -	Max -ve	0.000	0.000	0.000	41.048
				Max +ve	0.000	0.000	3.116	-25.098
			21:GROUP X -	Max -ve	0.000	0.000	0.000	22.447
				Max +ve	0.000	0.000	3.116	-15.269
			22:GROUP VII	Max -ve	0.000	0.000	0.000	60.617
				Max +ve	0.000	0.000	3.116	-36.461
3	4	7.150	20:GROUP X -	Max -ve	0.000	0.000	3.575	17.879
				Max +ve	0.000	0.000	7.150	-41.047
			21:GROUP X -	Max -ve	0.000	0.000	2.979	8.609
				Max +ve	0.000	0.000	7.150	-22.447
			22:GROUP VII	Max -ve	0.000	0.000	3.575	26.944
				Max +ve	0.000	0.000	7.150	-60.615
4	1	1.246	20:GROUP X -	Max -ve	0.000	0.000		
				Max +ve	0.000	0.000	0.000	-33.317
			21:GROUP X -	Max -ve	0.000	0.000	1.246	0.294
				Max +ve	0.000	0.000	0.000	-15.840
			22:GROUP VII	Max -ve	0.000	0.000		
				Max +ve	0.000	0.000	0.000	-50.127
5	5	1.246	20:GROUP X -	Max -ve	0.000	0.000	1.246	1.944
				Max +ve	0.000	0.000	0.000	-0.480
			21:GROUP X -	Max -ve	0.000	0.000	1.246	1.103
				Max +ve	0.000	0.000		
			22:GROUP VII	Max -ve	0.000	0.000	1.246	2.855
				Max +ve	0.000	0.000	0.000	-0.926
6	6	1.246	20:GROUP X -	Max -ve	0.000	0.000	0.000	1.944
				Max +ve	0.000	0.000		
			21:GROUP X -	Max -ve	0.000	0.000	0.000	1.103
				Max +ve	0.000	0.000		
			22:GROUP VII	Max -ve	0.000	0.000	0.000	2.855
				Max +ve	0.000	0.000		
7	7	1.246	20:GROUP X -	Max -ve	0.000	0.000	0.000	1.944
				Max +ve	0.000	0.000	1.246	-0.479
			21:GROUP X -	Max -ve	0.000	0.000	0.000	1.103
				Max +ve	0.000	0.000		
			22:GROUP VII	Max -ve	0.000	0.000	0.000	2.855
				Max +ve	0.000	0.000	1.246	-0.924
8	5	1.246	20:GROUP X -	Max -ve	0.000	0.000		
				Max +ve	0.000	0.000	1.246	-33.326
			21:GROUP X -	Max -ve	0.000	0.000	0.000	0.293

Beam Maximum Moments Cont...

Beam	Node A	Length (ft)	L/C		d (ft)	Max My (kip-in)	d (ft)	Max Mz (kip-in)
				Max +ve	0.000	0.000	1.246	-15.845
			22:GROUP VII	Max -ve	0.000	0.000		
				Max +ve	0.000	0.000	1.246	-50.141

Beam Force Detail

Sign convention as diagrams:- positive above line, negative below line except Fx where positive is compression. Distance d is given from beam end A.

			Axial	Shear		Torsion	Bending	
Beam	L/C	d (ft)	Fx (kip)	Fy (kip)	Fz (kip)	Mx (kip-in)	My (kip-in)	Mz (kip-in)
1	20:GROUP X -	0.000	4.235	2.728	0.000	0.000	0.000	33.317
		0.715	4.165	2.081	0.000	0.000	0.000	13.015
		1.430	4.095	1.463	0.000	0.000	0.000	-2.015
		2.145	4.026	0.874	0.000	0.000	0.000	-12.014
		2.860	3.956	0.314	0.000	0.000	0.000	-17.222
		3.575	3.886	-0.216	0.000	0.000	0.000	-17.877
		4.290	3.817	-0.712	0.000	0.000	0.000	-13.638
		5.005	3.747	-1.180	0.000	0.000	0.000	-5.386
		5.720	3.677	-1.618	0.000	0.000	0.000	6.639
		6.435	3.608	-2.026	0.000	0.000	0.000	22.196
		7.150	3.538	-2.406	-0.000	-0.000	-0.000	41.048
	21:GROUP X -	0.000	2.714	1.332	0.000	0.000	0.000	15.840
		0.715	2.644	1.008	0.000	0.000	0.000	5.964
		1.430	2.575	0.699	0.000	0.000	0.000	-1.278
		2.145	2.505	0.405	0.000	0.000	0.000	-6.003
		2.860	2.435	0.125	0.000	0.000	0.000	-8.332
		3.575	2.366	-0.140	0.000	0.000	0.000	-8.386
		4.290	2.296	-0.388	0.000	0.000	0.000	-5.992
		5.005	2.226	-0.622	0.000	0.000	0.000	-1.592
		5.720	2.157	-0.841	0.000	0.000	0.000	4.694
		6.435	2.087	-1.045	0.000	0.000	0.000	12.747
		7.150	2.017	-1.235	-0.000	-0.000	-0.000	22.447
	22:GROUP VII	0.000	6.098	4.091	0.000	0.000	0.000	50.127
		0.715	6.007	3.123	0.000	0.000	0.000	19.670
		1.430	5.917	2.199	0.000	0.000	0.000	-2.908
		2.145	5.826	1.319	0.000	0.000	0.000	-17.963
		2.860	5.736	0.482	0.000	0.000	0.000	-25.855
		3.575	5.645	-0.310	0.000	0.000	0.000	-26.941
		4.290	5.555	-1.053	0.000	0.000	0.000	-20.711
		5.005	5.464	-1.751	0.000	0.000	0.000	-8.481
		5.720	5.374	-2.406	0.000	0.000	0.000	9.388
		6.435	5.283	-3.017	0.000	0.000	0.000	32.541
		7.150	5.193	-3.584	-0.000	-0.000	-0.000	60.617
2	20:GROUP X -	0.000	2.406	3.538	0.000	0.000	0.000	41.048
		0.623	2.406	2.830	0.000	0.000	0.000	17.530

Beam Force Detail Cont...

			Axial	Shear		Torsion	Bending	
Beam	L/C	d (ft)	Fx (kip)	Fy (kip)	Fz (kip)	Mx (kip-in)	My (kip-in)	Mz (kip-in)
		1.246	2.406	2.123	0.000	0.000	0.000	-0.844
		1.870	2.406	1.415	0.000	0.000	0.000	-14.073
		2.493	2.406	0.708	0.000	0.000	0.000	-22.158
		3.116	2.406	0.000	0.000	0.000	0.000	-25.098
		3.739	2.405	-0.708	0.000	0.000	0.000	-22.158
		4.362	2.405	-1.415	0.000	0.000	0.000	-14.074
		4.986	2.405	-2.123	0.000	0.000	0.000	-0.845
		5.609	2.405	-2.830	0.000	0.000	0.000	17.528
		6.232	2.405	-3.538	-0.000	-0.000	-0.000	41.047
	21:GROUP X -	0.000	1.235	2.017	0.000	0.000	0.000	22.447
		0.623	1.235	1.614	0.000	0.000	0.000	9.037
		1.246	1.235	1.210	0.000	0.000	0.000	-1.440
		1.870	1.235	0.807	0.000	0.000	0.000	-8.983
		2.493	1.235	0.403	0.000	0.000	0.000	-13.593
		3.116	1.235	0.000	0.000	0.000	0.000	-15.269
		3.739	1.235	-0.403	0.000	0.000	0.000	-13.593
		4.362	1.235	-0.807	0.000	0.000	0.000	-8.983
		4.986	1.235	-1.210	0.000	0.000	0.000	-1.440
		5.609	1.235	-1.614	0.000	0.000	0.000	9.036
		6.232	1.235	-2.017	-0.000	-0.000	-0.000	22.447
	22:GROUP VII	0.000	3.584	5.192	0.000	0.000	0.000	60.617
		0.623	3.584	4.154	0.000	0.000	0.000	26.100
		1.246	3.584	3.115	0.000	0.000	0.000	-0.865
		1.870	3.584	2.077	0.000	0.000	0.000	-20.281
		2.493	3.584	1.038	0.000	0.000	0.000	-32.146
		3.116	3.584	0.000	0.000	0.000	0.000	-36.461
		3.739	3.584	-1.038	0.000	0.000	0.000	-32.146
		4.362	3.584	-2.077	0.000	0.000	0.000	-20.282
		4.986	3.584	-3.115	0.000	0.000	0.000	-0.867
		5.609	3.584	-4.154	0.000	0.000	0.000	26.099
		6.232	3.583	-5.192	-0.000	-0.000	-0.000	60.615
3	20:GROUP X -	0.000	4.234	-2.728	0.000	0.000	0.000	-33.326
		0.715	4.165	-2.081	0.000	0.000	0.000	-13.021
		1.430	4.095	-1.463	0.000	0.000	0.000	2.012
		2.145	4.025	-0.874	0.000	0.000	0.000	12.013
		2.860	3.956	-0.314	0.000	0.000	0.000	17.222
		3.575	3.886	0.216	0.000	0.000	0.000	17.879
		4.290	3.816	0.712	0.000	0.000	0.000	13.641
		5.005	3.747	1.180	0.000	0.000	0.000	5.389
		5.720	3.677	1.618	0.000	0.000	0.000	-6.636
		6.435	3.607	2.026	0.000	0.000	0.000	-22.194
		7.150	3.538	2.406	-0.000	-0.000	-0.000	-41.047
	21:GROUP X -	0.000	2.714	-1.332	0.000	0.000	0.000	-15.845
		0.715	2.644	-1.009	0.000	0.000	0.000	-5.966
		1.430	2.574	-0.699	0.000	0.000	0.000	1.276

Beam Force Detail Cont...

			Axial	Shear		Torsion	Bending	
Beam	L/C	d (ft)	Fx (kip)	Fy (kip)	Fz (kip)	Mx (kip-in)	My (kip-in)	Mz (kip-in)
		2.145	2.505	-0.405	0.000	0.000	0.000	6.003
		2.860	2.435	-0.125	0.000	0.000	0.000	8.333
		3.575	2.365	0.140	0.000	0.000	0.000	8.387
		4.290	2.296	0.388	0.000	0.000	0.000	5.994
		5.005	2.226	0.622	0.000	0.000	0.000	1.594
		5.720	2.157	0.841	0.000	0.000	0.000	-4.693
		6.435	2.087	1.045	0.000	0.000	0.000	-12.746
		7.150	2.017	1.235	-0.000	-0.000	-0.000	-22.447
	22:GROUP VII	0.000	6.098	-4.092	0.000	0.000	0.000	-50.141
		0.715	6.007	-3.123	0.000	0.000	0.000	-19.679
		1.430	5.916	-2.199	0.000	0.000	0.000	2.903
		2.145	5.826	-1.319	0.000	0.000	0.000	17.962
		2.860	5.735	-0.483	0.000	0.000	0.000	25.856
		3.575	5.645	0.310	0.000	0.000	0.000	26.944
		4.290	5.554	1.052	0.000	0.000	0.000	20.715
		5.005	5.464	1.751	0.000	0.000	0.000	8.486
		5.720	5.373	2.406	0.000	0.000	0.000	-9.384
		6.435	5.283	3.017	0.000	0.000	0.000	-32.537
		7.150	5.192	3.584	-0.000	-0.000	-0.000	-60.615
4	20:GROUP X -	0.000	0.000	-2.033	0.000	0.000	0.000	-33.317
		0.125	0.000	-2.065	0.000	0.000	0.000	-30.249
		0.249	0.000	-2.098	0.000	0.000	0.000	-27.135
		0.374	0.000	-2.130	0.000	0.000	0.000	-23.973
		0.499	0.000	-2.163	0.000	0.000	0.000	-20.763
		0.623	0.000	-2.196	0.000	0.000	0.000	-17.506
		0.748	0.000	-2.228	0.000	0.000	0.000	-14.196
		0.872	0.000	-2.261	0.000	0.000	0.000	-10.837
		0.997	0.000	-2.293	0.000	0.000	0.000	-7.432
		1.122	0.000	-2.326	0.000	0.000	0.000	-3.979
		1.246	-0.000	-2.358	-0.000	-0.000	-0.000	-0.479
	21:GROUP X -	0.000	0.000	-0.952	0.000	0.000	0.000	-15.840
		0.125	0.000	-0.977	0.000	0.000	0.000	-14.395
		0.249	0.000	-1.003	0.000	0.000	0.000	-12.913
		0.374	0.000	-1.028	0.000	0.000	0.000	-11.395
		0.499	0.000	-1.053	0.000	0.000	0.000	-9.839
		0.623	0.000	-1.079	0.000	0.000	0.000	-8.247
		0.748	0.000	-1.104	0.000	0.000	0.000	-6.612
		0.872	0.000	-1.129	0.000	0.000	0.000	-4.941
		0.997	0.000	-1.155	0.000	0.000	0.000	-3.233
		1.122	0.000	-1.180	0.000	0.000	0.000	-1.488
		1.246	-0.000	-1.205	-0.000	-0.000	-0.000	0.294
	22:GROUP VII	0.000	0.000	-3.064	0.000	0.000	0.000	-50.127
		0.125	0.000	-3.109	0.000	0.000	0.000	-45.507
		0.249	0.000	-3.154	0.000	0.000	0.000	-40.821
		0.374	0.000	-3.199	0.000	0.000	0.000	-36.070

Beam Force Detail Cont...

			Axial	Shear		Torsion	Bending	
Beam	L/C	d (ft)	Fx (kip)	Fy (kip)	Fz (kip)	Mx (kip-in)	My (kip-in)	Mz (kip-in)
		0.499	0.000	-3.245	0.000	0.000	0.000	-31.253
		0.623	0.000	-3.290	0.000	0.000	0.000	-26.370
		0.748	0.000	-3.335	0.000	0.000	0.000	-21.412
		0.872	0.000	-3.380	0.000	0.000	0.000	-16.388
		0.997	0.000	-3.425	0.000	0.000	0.000	-11.299
		1.122	0.000	-3.470	0.000	0.000	0.000	-6.144
		1.246	-0.000	-3.515	-0.000	-0.000	-0.000	-0.924
5	20:GROUP X -	0.000	0.000	0.001	0.000	0.000	0.000	-0.480
		0.125	0.000	-0.032	0.000	0.000	0.000	-0.454
		0.249	0.000	-0.064	0.000	0.000	0.000	-0.381
		0.374	0.000	-0.097	0.000	0.000	0.000	-0.260
		0.499	0.000	-0.130	0.000	0.000	0.000	-0.092
		0.623	0.000	-0.162	0.000	0.000	0.000	0.123
		0.748	0.000	-0.195	0.000	0.000	0.000	0.393
		0.872	0.000	-0.227	0.000	0.000	0.000	0.710
		0.997	0.000	-0.260	0.000	0.000	0.000	1.074
		1.122	0.000	-0.292	0.000	0.000	0.000	1.485
		1.246	-0.000	-0.325	-0.000	-0.000	-0.000	1.944
	21:GROUP X -	0.000	0.000	0.073	0.000	0.000	0.000	0.293
		0.125	0.000	0.047	0.000	0.000	0.000	0.206
		0.249	0.000	0.022	0.000	0.000	0.000	0.155
		0.374	0.000	-0.003	0.000	0.000	0.000	0.141
		0.499	0.000	-0.029	0.000	0.000	0.000	0.164
		0.623	0.000	-0.054	0.000	0.000	0.000	0.224
		0.748	0.000	-0.079	0.000	0.000	0.000	0.326
		0.872	0.000	-0.105	0.000	0.000	0.000	0.465
		0.997	0.000	-0.130	0.000	0.000	0.000	0.641
		1.122	0.000	-0.155	0.000	0.000	0.000	0.853
		1.246	-0.000	-0.181	-0.000	-0.000	-0.000	1.103
	22:GROUP VII	0.000	0.000	-0.027	0.000	0.000	0.000	-0.926
		0.125	0.000	-0.072	0.000	0.000	0.000	-0.848
		0.249	0.000	-0.117	0.000	0.000	0.000	-0.704
		0.374	0.000	-0.163	0.000	0.000	0.000	-0.495
		0.499	0.000	-0.208	0.000	0.000	0.000	-0.220
		0.623	0.000	-0.253	0.000	0.000	0.000	0.121
		0.748	0.000	-0.298	0.000	0.000	0.000	0.536
		0.872	0.000	-0.343	0.000	0.000	0.000	1.018
		0.997	0.000	-0.388	0.000	0.000	0.000	1.565
		1.122	0.000	-0.433	0.000	0.000	0.000	2.177
		1.246	-0.000	-0.479	-0.000	-0.000	-0.000	2.855
6	20:GROUP X -	0.000	0.000	0.163	0.000	0.000	0.000	1.944
		0.125	0.000	0.130	0.000	0.000	0.000	1.728
		0.249	0.000	0.098	0.000	0.000	0.000	1.558
		0.374	0.000	0.065	0.000	0.000	0.000	1.437
		0.499	0.000	0.033	0.000	0.000	0.000	1.362

Beam Force Detail Cont...

Beam	L/C	d (ft)	Axial Fx (kip)	Shear Fy (kip)	Shear Fz (kip)	Torsion Mx (kip-in)	Bending My (kip-in)	Bending Mz (kip-in)
		0.623	0.000	0.000	0.000	0.000	0.000	1.335
		0.748	0.000	-0.033	0.000	0.000	0.000	1.362
		0.872	0.000	-0.065	0.000	0.000	0.000	1.437
		0.997	0.000	-0.098	0.000	0.000	0.000	1.558
		1.122	0.000	-0.130	0.000	0.000	0.000	1.727
		1.246	-0.000	-0.163	-0.000	-0.000	-0.000	1.944
	21:GROUP X -	0.000	0.000	0.127	0.000	0.000	0.000	1.103
		0.125	0.000	0.101	0.000	0.000	0.000	0.934
		0.249	0.000	0.076	0.000	0.000	0.000	0.803
		0.374	0.000	0.051	0.000	0.000	0.000	0.708
		0.499	0.000	0.025	0.000	0.000	0.000	0.650
		0.623	0.000	0.000	0.000	0.000	0.000	0.629
		0.748	0.000	-0.025	0.000	0.000	0.000	0.650
		0.872	0.000	-0.051	0.000	0.000	0.000	0.708
		0.997	0.000	-0.076	0.000	0.000	0.000	0.803
		1.122	0.000	-0.101	0.000	0.000	0.000	0.934
		1.246	-0.000	-0.127	-0.000	-0.000	-0.000	1.103
	22:GROUP VII	0.000	0.000	0.226	0.000	0.000	0.000	2.855
		0.125	0.000	0.181	0.000	0.000	0.000	2.555
		0.249	0.000	0.135	0.000	0.000	0.000	2.321
		0.374	0.000	0.090	0.000	0.000	0.000	2.152
		0.499	0.000	0.045	0.000	0.000	0.000	2.049
		0.623	0.000	0.000	0.000	0.000	0.000	2.011
		0.748	0.000	-0.045	0.000	0.000	0.000	2.049
		0.872	0.000	-0.090	0.000	0.000	0.000	2.152
		0.997	0.000	-0.135	0.000	0.000	0.000	2.321
		1.122	0.000	-0.181	0.000	0.000	0.000	2.555
		1.246	-0.000	-0.226	-0.000	-0.000	-0.000	2.855
7	20:GROUP X -	0.000	0.000	0.325	0.000	0.000	0.000	1.944
		0.125	0.000	0.292	0.000	0.000	0.000	1.485
		0.249	0.000	0.260	0.000	0.000	0.000	1.074
		0.374	0.000	0.227	0.000	0.000	0.000	0.710
		0.499	0.000	0.195	0.000	0.000	0.000	0.393
		0.623	0.000	0.162	0.000	0.000	0.000	0.124
		0.748	0.000	0.129	0.000	0.000	0.000	-0.091
		0.872	0.000	0.097	0.000	0.000	0.000	-0.259
		0.997	0.000	0.064	0.000	0.000	0.000	-0.380
		1.122	0.000	0.032	0.000	0.000	0.000	-0.453
		1.246	-0.000	-0.001	-0.000	-0.000	-0.000	-0.479
	21:GROUP X -	0.000	0.000	0.181	0.000	0.000	0.000	1.103
		0.125	0.000	0.155	0.000	0.000	0.000	0.853
		0.249	0.000	0.130	0.000	0.000	0.000	0.641
		0.374	0.000	0.105	0.000	0.000	0.000	0.465
		0.499	0.000	0.079	0.000	0.000	0.000	0.327
		0.623	0.000	0.054	0.000	0.000	0.000	0.225

Beam Force Detail Cont...

			Axial	Shear		Torsion	Bending	
Beam	L/C	d (ft)	Fx (kip)	Fy (kip)	Fz (kip)	Mx (kip-in)	My (kip-in)	Mz (kip-in)
		0.748	0.000	0.029	0.000	0.000	0.000	0.165
		0.872	0.000	0.003	0.000	0.000	0.000	0.142
		0.997	0.000	-0.022	0.000	0.000	0.000	0.156
		1.122	0.000	-0.047	0.000	0.000	0.000	0.206
		1.246	-0.000	-0.073	-0.000	-0.000	-0.000	0.294
	22:GROUP VII	0.000	0.000	0.478	0.000	0.000	0.000	2.855
		0.125	0.000	0.433	0.000	0.000	0.000	2.177
		0.249	0.000	0.388	0.000	0.000	0.000	1.565
		0.374	0.000	0.343	0.000	0.000	0.000	1.018
		0.499	0.000	0.298	0.000	0.000	0.000	0.537
		0.623	0.000	0.253	0.000	0.000	0.000	0.122
		0.748	0.000	0.208	0.000	0.000	0.000	-0.219
		0.872	0.000	0.162	0.000	0.000	0.000	-0.494
		0.997	0.000	0.117	0.000	0.000	0.000	-0.703
		1.122	0.000	0.072	0.000	0.000	0.000	-0.846
		1.246	-0.000	0.027	-0.000	-0.000	-0.000	-0.924
8	20:GROUP X -	0.000	0.000	2.359	0.000	0.000	0.000	-0.480
		0.125	0.000	2.326	0.000	0.000	0.000	-3.981
		0.249	0.000	2.294	0.000	0.000	0.000	-7.435
		0.374	0.000	2.261	0.000	0.000	0.000	-10.841
		0.499	0.000	2.229	0.000	0.000	0.000	-14.200
		0.623	0.000	2.196	0.000	0.000	0.000	-17.512
		0.748	0.000	2.163	0.000	0.000	0.000	-20.769
		0.872	0.000	2.131	0.000	0.000	0.000	-23.979
		0.997	0.000	2.098	0.000	0.000	0.000	-27.142
		1.122	0.000	2.066	0.000	0.000	0.000	-30.258
		1.246	-0.000	2.033	-0.000	-0.000	-0.000	-33.326
	21:GROUP X -	0.000	0.000	1.206	0.000	0.000	0.000	0.293
		0.125	0.000	1.180	0.000	0.000	0.000	-1.489
		0.249	0.000	1.155	0.000	0.000	0.000	-3.234
		0.374	0.000	1.130	0.000	0.000	0.000	-4.943
		0.499	0.000	1.104	0.000	0.000	0.000	-6.615
		0.623	0.000	1.079	0.000	0.000	0.000	-8.249
		0.748	0.000	1.054	0.000	0.000	0.000	-9.842
		0.872	0.000	1.028	0.000	0.000	0.000	-11.398
		0.997	0.000	1.003	0.000	0.000	0.000	-12.917
		1.122	0.000	0.978	0.000	0.000	0.000	-14.399
		1.246	-0.000	0.952	-0.000	-0.000	-0.000	-15.845
	22:GROUP VII	0.000	0.000	3.516	0.000	0.000	0.000	-0.926
		0.125	0.000	3.471	0.000	0.000	0.000	-6.147
		0.249	0.000	3.426	0.000	0.000	0.000	-11.303
		0.374	0.000	3.381	0.000	0.000	0.000	-16.394
		0.499	0.000	3.336	0.000	0.000	0.000	-21.418
		0.623	0.000	3.291	0.000	0.000	0.000	-26.378
		0.748	0.000	3.245	0.000	0.000	0.000	-31.262

Beam Force Detail Cont...

			Axial	Shear		Torsion	Bending	
Beam	L/C	d (ft)	Fx (kip)	Fy (kip)	Fz (kip)	Mx (kip-in)	My (kip-in)	Mz (kip-in)
		0.872	0.000	3.200	0.000	0.000	0.000	-36.080
		0.997	0.000	3.155	0.000	0.000	0.000	-40.833
		1.122	0.000	3.110	0.000	0.000	0.000	-45.520
		1.246	-0.000	3.065	-0.000	-0.000	-0.000	-50.141

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Section 5
Bill of Quantities

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BILL OF QUANTITIES

Item	Units	RC Beam	Culvert	Highway	Total
Item 03 30 00 - Cast-In-Place Concrete					
Concrete	M^3	3490	50	185	3725
Reinforcement Steel	kg	285000	4000		289000
Item 07 11 13 - Bituminous Dampproofing					
Bituminous Damproofing	M^2	240	170		410
Item 07 95 63 - Elastomeric Bridge Bearings					
Bearings	Ea	130	0		130
Item 07 95 65 - Asphaltic Bridge Joints					
Asphaltic Joint	M	110	0		110
Item 31 10 00 - Site Clearing and Preparation					
Site Preparation	M^2			9750	9750
Clearing and grubbing	M^2			700	700
Item 31 20 00 - Earth Moving					
Excavation	M^3	8370	320	125	8815
Gravel Borrow	M^3	6840	730	165	7735
No. 1 Crushed Stone -37.5 mm	M^3			1075	1075
No. 2 Crushed stone - 50 mm	M^3			100	100
Processed gravel	M^3			800	800
Select Fill	M^3			5200	5200
Fine grading and compacting	M^2			2300	2300
Item 31 25 00 - Erosion and Sedimentation Controls					
Silt fence	M			500	500
Item 31 37 00 - Riprap					
Rip-rap	M^3			11820	11820
Woven geotextile	M^2			7130	7130
Item 31 37 00 - Cofferdams					
Cofferdam	LS				1
Control of Water	LS				1
Item 32 32 40 - Stone masonry Walls					
Stone masonry walls	M			370	370

Reinforced Concrete Beams Quantities

Loading HS25/MLC-70(Wheeled)/MLC-70(Tracked)

Bridge Length =	195	m
Span Length =	15	m
No. of Spans =	13	

Concrete	Length (m)	Width (m)	Height (m)	Volume (m^3)	Qty	Total Volume (m^3)
Abutments						
Abutment Footing	12.00	6.50	1.00	78.00	2	156.00
Abutment Stem	9.50	1.30	6.10	75.34	2	150.67
Abutment Backwall	9.50	0.30	1.88	5.36	2	10.72
Abutment Batter	9.50	1.70	6.10	49.26	2	98.52
Abutment Keeper Block	0.45	1.30	1.34	0.78	4	3.12
Approach Slab	5.00	8.60	0.27	11.48	2	22.96
Abutment Totals				220.21		441.99
Piers						
Pier Footing	12.00	3.90	0.75	35.10	12	421.20
Pier Stem	9.50	1.50	4.65	66.26	12	795.15
Pier Ends	0.75	0.75	5.99	3.37	24	80.80
Pier Keeper	0.45	1.50	1.34	0.90	24	21.63
Pier Totals				105.63		1318.77
Superstructure						
Beam	13.55	0.60	1.25	10.16	65	660.56
End Diaphragm	8.55	0.70	1.25	7.43	26	193.12
Interior Diaphagm	1.50	0.30	1.00	0.45	52	23.40
Deck	195.85	9.50	0.32	589.80	1	589.80
Wearing Surface	195.85	0.00	0.00	0.00	1	0.00
Barrier	195.85	0.45	1.05	92.54	2	185.08
Sidewalk + Curb	195.85	1.65	0.21	68.51	1	68.51
Superstructure Totals				768.89		1720.47
Concrete Totals						3481
Say --->						**3490** m^3

Reinforcement Steel	Volume (m^3)	Volume (cy)	#Steel/ cy Conc	Steel (lbs)	Qty	Total Steel (lbs)
Abutments						
Abutment Footing	78.00	102.02	120	12242.41	2	24484.82
Abutment Stem	75.34	98.53	100	9853.44	2	19706.88
Abutment Backwall	5.36	7.01	150	1051.20	2	2102.40
Abutment Batter	49.26	64.43	100	6442.63	2	12885.27
Abutment Keeper Block	0.78	1.02	150	153.22	4	612.89
Approach Slab	11.48	15.02	150	2252.49	2	4504.97
Abutment Totals				29742.91		59792.26
Piers						
Pier Footing	35.10	45.91	120	5509.09	12	66109.02
Pier Stem	66.26	86.67	100	8666.80	12	104001.64
Pier Ends	3.37	4.40	150	660.49	24	15851.86
Pier Keeper	0.90	1.18	150	176.79	24	4243.06
Pier Totals				15013.18		190205.59
Superstructure						
Beam	10.16	13.29	150	1993.81	65	129597.41
End Diaphragm	7.43	9.72	150	1457.28	26	37889.31
Interior Diaphagm	0.45	0.59	150	88.29	52	4590.90
Deck	589.80	771.43	200	154286.38	1	154286.38
Wearing Surface	0.00	0.00	200	0.00	1	0.00
Barrier	92.54	121.04	150	18155.48	2	36310.96
Sidewalk + Curb	68.51	89.61	150	13440.82	1	13440.82
Superstructure Totals				189422.05		376115.78
Steel Totals						626114 lbs
Steel Totals						284000 kg
Say --->						**285000** kg

Excavation	Bot Length (m)	Bot Width (m)	Top Length (m)	Top Width (m)	Height (m)	Volume (m^3)	Qty	Total Volume (m^3)
Substructure								
Abutment	14.40	8.90	25.80	20.30	4.85	1092.68	2	2185.36
Pier	13.20	5.10	23.86	15.76	2.66	514.71	12	6176.54
Excavation Totals						1607.392397		8362
Say --->								**8370**

Backfill	Bot Length (m)	Bot Width (m)	Top Length (m)	Top Width (m)	Height (m)	Volume (m^3)	Qty	Total Volume (m^3)
Abutment								
Abutement Backfill Area (total)	14.40	8.90	26.70	21.20	8.15	2158.38	2	4316.75
Minus Abutment Concrete						-160.23		-320.46
Minus Area in front of Abutment	24.10	6.05	26.70	9.35	3.30	-645.41	2	-1290.828
Abutment Totals						1352.73		2705.46
Pier								
Pier Excavation Area (total)	13.20	5.10	23.86	15.76	2.66	514.71	12	6176.54
Pier Footing			12.00	3.90	0.75	-35.10	12	-421.20
Pier Stem			9.50	1.50	1.91	-27.27	12	-327.29
Pier Rip Rap	16.25	7.50	16.25	7.50	1.50	182.81	12	-2193.75
Pier Totals						452.34		3234.29
Excavation Totals						452.3368974		5940
Say --->								**6840**

Elastomeric Bearings	# of Spans	Beams Per Span	Bearing Per Beam			Total Qty (#)
Abutment and Piers						
Elastomeric Bearings	13.00	5.00	2.00			130

Asphaltic Bridge Joints	Lane Width (m)	Number of Lanes	# Of Joints			Total Joint Length (m)	
Abutment and Piers							
Asphaltic Bridge Joints	3.70	2.00	14.00			103.6	
						104	
Say --->						**110**	m

Bituminous Damproofing	Length (m)	Hieght (m)	Area (m^2)	Qty	Total Area (m^2)	
Abutments						
Behind Abutment Stem	9.50	7.76	73.71	2	147.42	
Top of Approach Slab	8.60	5.00	43.00	2	86.00	
			116.71		233.42	
					233	
Say --->					**240**	m^2

Culvert Quantities

Concrete	Length (m)	Width (m)	Height (m)	Volume (m^3)	Qty	Total Volume (m^3)	
Culvert							
Culvert Base Slab	23.40	2.10	0.30	14.74	1	14.74	
Culvert Wall	23.40	0.20	1.93	9.03	2	18.06	
Culvert Roof Slab	23.40	2.10	0.20	9.83	1	9.83	
Culvert Chamfer	23.40	0.10	0.20	0.23	4	0.94	
Culvert End Curb	0.35	2.10	0.30	0.22	2	0.44	
Culvert Totals				34.06		44.01	
Superstructure							
Barrier	0.00	0.45	1.05	0.00	2	0.00	
Superstructure Totals				0.00		0.00	
Concrete Totals						44	
Say --->						**50**	m^3

Reinforcement Steel	Volume (m^3)	Volume (cy)	#Steel/ cy Conc	Steel (lbs)	Qty	Total Steel (lbs)	
Culvert							
Culvert Base Slab	14.74	19.28	150	2892.27	1	2892.27	
Culvert Wall	9.03	11.81	150	1772.09	2	3544.18	
Culvert Roof Slab	9.83	12.85	150	1928.18	1	1928.18	
Culvert Chamfer	0.23	0.31	150	45.91	4	183.64	
Culvert End Curb	0.22	0.29	150	43.26	2	86.52	
Culvert Totals				6681.71		8634.79	
Superstructure							
Barrier	0.00	0.00	150	0.00	2	0.00	
Superstructure Totals				0.00		0.00	
Steel Totals						8635	
Steel Totals						3917	kg
Say --->						**4000**	kg

Excavation	Bot Length (m)	Bot Width (m)	Top Length (m)	Top Width (m)	Height (m)	Volume (m^3)	Qty	Total Volume (m^3)	
Culvert									
Culvert	24.60	3.30	31.40	10.10	1.70	318.92	1	318.92	
Excavation Totals						318.92		319	
Say --->								**320**	m^3

Backfill	Bot Length (m)	Bot Width (m)	Top Length (m)	Top Width (m)	Height (m)	Volume (m^3)	Qty	Total Volume (m^3)	
Culvert									
Total Backfill Area	24.60	3.30	13.40	12.98	4.84	748.55	1	748.5544	
Culvert Volume						-119.41		-119.41	
Excavation Totals						629.1442		629.1442	
Say --->								**730**	m^3

Bituminous Dampproofing	Length (m)	Width (m)	Area (m^2)	Qty	Total Area (m^2)	
Culvert						
Top of Roof Slab	23.40	2.10	49.14	1	49.14	
Culvert Walls	23.40	2.43	56.86	2	113.72	
			106.00		162.86	
					163	
Say --->					**170**	m^2

SITE PREPARATION

APPROXIMATE AREA OF WORK = 9,739.6868 S.M. (AREA TAKEN FROM AUTO CAD)

SITE PREPARATION = 9,750 S.M.

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SHEET NO. 1 OF 14

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CHECKED BY DATE

SCALE

CLEARING AND GRUBBING

APPROXIMATE AREA OF CLEARING AND GRUBBING = 684.4717 S.M.

(AREA TAKEN FROM AUTOCAD)

CLEARING AND GRUBBING = 700 S.M.

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SCALE

SILT FENCE

* CONTINGENT ITEM

SILT FENCE = 500 L.M.

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SCALE

EARTH EXCAVATION

APPROXIMATE EARTH EXCAVATION = 106.32 C.M. (VOLUME TAKEN FROM AUTOCAD)

× 15% → 122.268 C.M.

EARTH EXCAVATION = 125 C.M.

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SHEET NO. 4 OF 14

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SCALE

No. 1 Crushed Stone

* No. 1 Crushed Stone to be used under riprap
* No. 1 Crushed Stone to be installed w/ a thickness of 150mm

Area of No. 1 Crushed Stone = 0.5m Depth Riprap Area
+ 1.5m Depth Riprap Area − (Toe Length × 2)
+ Toe Length × 2m deep

Area of No. 1 Crushed Stone = 3,200 s.m. + 3,000 s.m. − (310m × 2m) + 310m × 2m
= 3,200 s.m. + 2,380m + 620m
= 6,200 s.m.

Volume of No. 1 Crushed Stone = 6,200 s.m. × 0.15m
= 930 c.m.
× 15% → 1,069.5 c.m.

No. 1 Crushed Stone = 1,075 c.m.

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SCALE

No. 2 CRUSHED STONE (19 MM)

*CONTINGENT ITEM

No. 2 CRUSHED STONE = 100 C.M.

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SCALE

PROCESSED GRAVEL (FOR ROADWAY SURFACES AND SHOULDERS)

* PROCESSED GRAVEL SHALL BE INSTALLED W/ A THICKNESS OF 300MM

APPROXIMATE AREA OF ROADWAY SURFACES AND SHOULDERS = 2,289.8323 S.M.

(AREA TAKEN FROM AUTOCAD)

VOLUME OF PROCESSED GRAVEL = 2,300 S.M. × 0.300M

= 690 C.M.

× 15% ⟶ 793.50 C.M.

PROCESSED GRAVEL = 800 C.M.

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SHEET NO. 7 OF 14

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SCALE

FINE GRADING AND COMPACTING (FOR ROADWAY SURFACES AND SHOULDERS)

APPROXIMATE AREA OF ROADWAY SURFACES AND SHOULDERS = 2,289.8323 S.M.

(AREA TAKEN FROM AUTOCAD)

APPROXIMATE AREA OF FINE GRADING AND COMPACTING = 2,289.8323 S.M.

FINE GRADING AND COMPACTING = 2,300 S.M.

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SHEET NO. 8 OF 14
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SCALE

GRAVEL BORROW

*GRAVEL BORROW SHALL BE INSTALLED WITH A THICKNESS OF 150mm

APPROXIMATE AREA OF GRAVEL BORROW = 931.4522 S.M.

(AREA TAKEN FROM AUTO CAD)

VOLUME OF GRAVEL BORROW = 940 S.M. × 0.150M

= 141 C.M.

× 15% ⟶ 162.15 C.M.

$\boxed{\text{GRAVEL BORROW} = 165 \text{ C.M.}}$

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SHEET NO. 9 OF 14

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SCALE

SELECT FILL

* NET FILL = 15,896.66 C.M. (VOLUME FROM AUTOCAD CUT-FILL ANALYSIS)

SELECT FILL = NET FILL − NO. 1 CRUSHED STONE (PG. 5) − NO. 2 CRUSHED STONE

RIPRAP = VOLUME OF 0.5M DEPTH + VOLUME OF 1.5M DEPTH
1600 + 4500 = 6100

− PROCESSED GRAVEL (PG. 7) − GRAVEL BORROW (PG. 9)

− RIPRAP (PG. 11) − CAST-IN-PLACE CONCRETE (PG. 14)

SELECT FILL = 15,900 C.M. − 1,075 C.M. − 100 C.M.
− 800 C.M. − 2,915 C.M.
− 6,200 C.M. − 185 C.M.

SELECT FILL = 4,625 C.M.

SUBTRACT CONCRETE CULVERT AREA = 120 C.M.

SELECT FILL VOLUME = 4,505 C.M.

× 15% → 5,180.75 C.M.

SELECT FILL = 5,200 C.M.

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SCALE

RIPRAP

APPROXIMATE AREA OF 0.5m DEPTH RIPRAP = 3,180.3846 S.M. (AREA TAKEN FROM AUTOCAD)

ASSUME 3,200 S.M.

VOLUME OF RIPRAP = 3,200 S.M. × 0.5m

— VOLUME OF RIPRAP = 1,600 C.M.

APPROXIMATE AREA OF 1.5m DEPTH RIPRAP = 2,971.6106 S.M. (AREA TAKEN FROM AUTOCAD)

ASSUME 3,000 S.M.

VOLUME OF RIPRAP = 3,000 S.M. × 1.5m

— VOLUME OF RIPRAP = 4,500 C.M.

APPROXIMATE RIPRAP TOE LENGTH = 306.7636 L.M. (LENGTH TAKEN FROM AUTOCAD)

ASSUME 310 L.M.

DEPTH = 2.5m
AVG. WIDTH = 2m

VOLUME OF RIPRAP TOE = 310 L.M. × 2.5m × 2m

— VOLUME OF RIPRAP TOE = 1,550 C.M.

— VOLUME OF PIER RIPRAP = 2,200 C.M. (FROM STRUCTURAL GROUP)

TOTAL VOLUME OF RIPRAP = 1,600 C.M. + 4,500 C.M. + 1,550 C.M. + 2,200 C.M.
= 9,850 C.M.

× 20% → 11,820 C.M.

$\boxed{\text{TOTAL VOLUME OF RIPRAP} = 11{,}820 \text{ C.M.}}$

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SCALE

WOVEN GEOTEXTILE

* WOVEN GEOTEXTILE TO BE INSTALLED UNDER RIPRAP

* WOVEN GEOTEXTILE AREA TO BE EQUAL TO AREA OF No. 1 CRUSHED STONE (+ 15%)
(SEE PAGE 5 FOR CALCULATION)

WOVEN GEOTEXTILE AREA = 6,200 S.M. + 15%

= 7,130 S.M.

WOVEN GEOTEXTILE = 7,130 S.M.

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SHEET NO. 12 OF 14

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SCALE

STONE MASONRY WALLS

APPROXIMATE LENGTH OF STONE MASONRY WALLS = 362.2949 L.M.

(LENGTH TAKEN FROM AUTOCAD)

STONE MASONRY WALLS = 370 L.M.

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SCALE

CAST-IN-PLACE CONCRETE (FOR STONE MASONRY WALL FOUNDATION)

* LENGTH OF STONE MASONRY WALL = 370 L.M.
* BASE TO BE 1M WIDE x 0.5M DEEP

CAST-IN PLACE CONCRETE = 370 L.M. x 1M x 0.5M

= 185 C.M.

CAST-IN-PLACE CONCRETE = 185 C.M.

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