ok RJ

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 63222670 Date 5/23/12 Initials RAT Region (A B C D)

Site _____ Location 2 mi N + 1.1 mi E of Chancellor on 275 St

Q_{100} = Q2 373 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 373 (should be Q_{100} unless there is a relief bridge, road overflow, or bridge overtopping)

Analytical Procedure for Estimating Hydraulic Variables Needed to Apply Method

PGRM: "RegionA", "RegionB", "RegionC", or "RegionD"

Bridge Width = 43 ft. Flow angle at bridge = 35 ° Abut. Skew = 0 ° Effective Skew = 35 °

Width (W_2) iteration = _____ _____ _____ _____

Avg. flow depth at bridge, y_2 iteration = _____ _____ _____ _____

Corrected channel width at bridge Section = W_2 times cos of flow angle = 35.22 ft* $q_2 = Q_2/W_2$ = 10.6 ft^2/s

Bridge Vel, V_2 = 2.3 ft/s Final $y_2 = q_2/V_2$ = 4.6 ft Δh = 0.1 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 4.7 ft

** NOTE: repeat above calculations until y_2 changes by less than 0.2* *Effective pier width = L sin(q) + a cos(q)*

If y_2 is above LS, then account for Road Overflow using PRGM: RDOVREGA, RDOVREGB, RDOVREGC, or RDOVREGD,

Water Surface Elev. = 0 ft

Low Steel Elev. = 5.6 ft

n (Channel) = 0.030

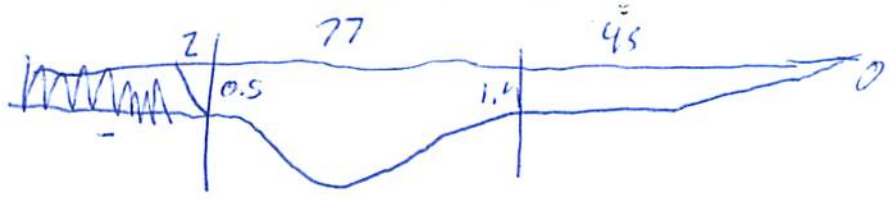
n (LOB) = 0.030

n (ROB) = 0.030

Pier Width = 0 ft

Pier Length = 0 ft

Piers for 100 yr = 0 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 77 ft

Width of left overbank flow at approach, W_{lob} = 2 ft Average left overbank flow depth, y_{lob} = 0.5 ft

Width of right overbank flow at approach, W_{rob} = 43 ft Average right overbank flow depth, y_{rob} = 0.9 ft

Live Bed Contraction Scour (use if bed material is small cobbles or finer)

x = 5.95 From Figure 9 W_2 (effective) = 35.2 ft y_{cs} = 6.7 ft

PGRM: CWCSNEW

Clear Water Contraction Scour (use if bed material is larger than small cobbles)

Estimated bed material D_{50} = _____ ft Average approach velocity, $V_1 = Q_{100}/(y_1 W_1)$ = _____ ft/s

Critical approach velocity, $Vc = 11.17 y_1^{1/6} D_{50}^{1/3}$ = _____ ft/s

If $V_1 < V_c$ and $D_{50} >= 0.2$ ft, use clear water equation below, otherwise use live bed scour equation above.

$D_{c50} = 0.0006(q_2/y_1^{7/6})^3$ = _____ ft If $D_{50} >= D_{c50}$, $\chi = 0.0$

Otherwise, $\chi = 0.122 y_1 [q_2/(D_{50}^{1/3} y_1^{7/6})]^{6/7} - y_1$ = _____ From Figure 10, y_{cs} = _____ ft

PGRM: Pier

PIER SCOUR CALCULATIONS

L/a ratio = 00 Correction factor for flow angle of attack (from Table 1), K2 = _____

Froude # at bridge = _____ Using pier width a on Figure 11, ξ = _____ Pier scour y_{ps} = _____ ft

PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, y_{aLT} = 0.5 ft ~~right abutment, y_{aRT}~~ = 0.9 ft

Shape coefficient K_1= 1.00 for vertical-wall, ~~0.82 for vertical-wall with wingwalls,~~ 0.55 for spill-through

Using values for y_{aLT} and y_{aRT} on figure 12, ψ_{LT} = 2.3 and ψ_{RT} = 3.9

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 3.4 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 5.8 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 63222070 Date 5/23/12 Initials RAH Region (A B C D)

Site _____ Location 2mi N & 1.1mi E of Chancellor on 275 St

Q_{500} = 925 964 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 554 (should be Q_{500} unless there is a relief bridge, road overflow, or bridge overtopping)

Analytical Procedure for Estimating Hydraulic Variables Needed to Apply Method

PGRM: "RegionA", "RegionB", "RegionC", or "RegionD"

Bridge Width = 43 ft. Flow angle at bridge = 35 ° Abut. Skew = 0 ° Effective Skew = 35 °

Width (W_2) iteration = _____ _____ _____ _____

Avg. flow depth at bridge, y_2 iteration = _____ _____ _____ _____

Corrected channel width at bridge Section = W_2 times cos of flow angle = 35.22 ft* $q_2 = Q_2/W_2$ = 15.7 ft^2/s

Bridge Vel, V_2 = 2.8 ft/s Final $y_2 = q_2/V_2$ = 5.6 ft Δh = 0.2 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 5.8 ft

* *NOTE: repeat above calculations until y_2 changes by less than 0.2* *Effective pier width = L sin(q) + a cos(q)*

If y_2 is above LS, then account for Road Overflow using PRGM: RDOVREGA, RDOVREGB, RDOVREGC, or RDOVREGD,

Water Surface Elev. = 0 ft

Low Steel Elev. = 5.6 ft

n (Channel) = 0.030

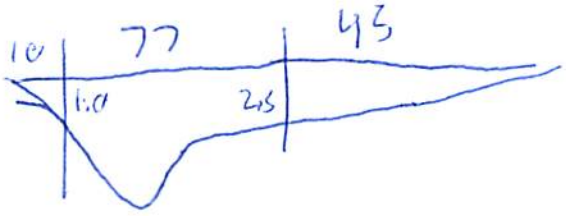
n (LOB) = 0.030

n (ROB) = 0.030

Pier Width = 0 ft

Pier Length = 0 ft

Piers for 500 yr = 0 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 77 ft

Width of left overbank flow at approach, W_{lob} = 10 ft Average left overbank flow depth, y_{lob} = 1.0 ft

Width of right overbank flow at approach, W_{rob} = 43 ft Average right overbank flow depth, y_{rob} = 1.7 ft

Live Bed Contraction Scour (use if bed material is small cobbles or finer)

x = 1.88 From Figure 9 W_2 (effective) = 352 ft y_{cs} = 8.7 ft

PGRM: CWCSNEW

Clear Water Contraction Scour (use if bed material is larger than small cobbles)

Estimated bed material D_{50} = _____ ft Average approach velocity, $V_1 = Q_{500}/(y_1W_1)$ = _____ ft/s

Critical approach velocity, $Vc = 11.17y_1^{1/6}D_{50}^{1/3}$ = _____ ft/s

If $V_1 < V_c$ and $D_{50} >= 0.2$ ft, use clear water equation below, otherwise use live bed scour equation above.

$D_{c50} = 0.0006(q_2/y_1^{7/6})^3$ = _____ ft If $D_{50} >= D_{c50}$, $\chi = 0.0$

Otherwise, $\chi = 0.122y_1[q_2/(D_{50}^{1/3}y_1^{7/6})]^{6/7} - y_1$ = _____ From Figure 10, y_{cs} = _____ ft

PGRM: Pier

PIER SCOUR CALCULATIONS

L/a ratio = _____ Correction factor for flow angle of attack (from Table 1), K2 = _____

Froude # at bridge = _____ Using pier width a on Figure 11, ξ = _____ Pier scour y_{ps} = _____ ft

PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, y_{aLT} = 1.0 ft right abutment, y_{aRT} = 1.7 ft

Shape coefficient K_1= 1.00 for vertical-wall, 0.82 for vertical-wall with wingwalls, 0.55 for spill-through

Using values for y_{aLT} and y_{aRT} on figure 12, ψ_{LT} = 4.3 and ψ_{RT} = 7

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 6.4 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 10.5 ft

Route 275 St Stream Long Ck MRM _____ Date 5/23/12 Initials RAT

Bridge Structure No. 63222070 Location 2 mi N & 1.1 mi E of Chancellor on 275 St

GPS coordinates: N 43° 24' 9.9" W 96° 51' 41.5" taken from: USL abutment X centerline of ⇑ MRM end _____

Datum of coordinates: WGS84 X NAD27 X

Drainage area = 33.13 sq. mi.

The average bottom of the main channel was 10.0 ft below top of guardrail at a point 22 ft from left abutment.

Method used to determine flood flows: ____Freq. Anal. ____drainage area ratio X regional regression equations.

MISCELLANEOUS CONSIDERATIONS

Flows	$Q_{\cancel{100}\ 2}$ = ~~535~~ 373			$Q_{\cancel{500}\ 5}$ = 944		
Estimated flow passing through bridge	373			554		
Estimated road overflow & overtopping	0			390		
Consideration	Yes	No	Possibly	Yes	No	Possibly
Chance of overtopping		X	~~X~~	X 1.1 ft		
Chance of Pressure flow		~~X~~	X	X		
Armored appearance to channel		X			X	
Lateral instability of channel		X			X	

8/26

2	535
5	1430
10	2320
25	3840
50	5250
100	6910
500	11800

5/22

2	373
5	944
10	1470
25	2320
50	3070
100	3910
500	6210

Riprap at abutments? ____Yes X No ____Marginal

Evidence of past Scour? X Yes ____No ____Don't know abutment & contract.

Debris Potential? ____High ____Med X Low

Does scour countermeasure(s) appear to have been designed?

Riprap	____Yes	X No	____Don't know	____NA
Spur Dike	____Yes	X No	____Don't know	____NA
Other _____	____Yes	X No	____Don't know	____NA

Bed Material Classification Based on Median Particle Size (D_{50})

Material	Silt/Clay X	Sand____	Gravel____	Cobbles____	Boulders____
Size range, in mm	<0.062	0.062-2.00	2.00-64	64-250	>250

Comments, Diagrams & orientation of digital photos

Pictures
1. L. Abut
2. R. Abut
3. Abut Scour
4. Cont. Scour
5. Left OB
6. main channel
7. bridge
8. R. OB

Summary of Results

	~~Q100~~ 2	~~Q500~~ 5
Bridge flow evaluated	373	554
Flow depth at left abutment (yaLT), in feet	0.5	1.0
Flow depth at right abutment (yaRT), in feet	0.9	1.7
Contraction scour depth (ycs), in feet	6.7	8.7
Pier scour depth (yps), in feet	~~0~~ NA	~~0~~ NA
Left abutment scour depth (yas), in feet	3.4	6.4
Right abutment scour depth (yas), in feet	5.8	10.5
1Flow angle of attack	35	35

See Comments/Diagram for justification where required