OK RT

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 25410219 Date 7/18/12 Initials RaT Region (A B [✓ C] D)

Site ______ Location 2mi N of Zell on 372nd Av

Q_{100} = Q_{10} 776 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 776 (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 = 46 ft. Flow angle at bridge = 15 ° Abut. Skew = 0 ° Effective Skew = 15 °

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 = 44.93 ft* $q_2 = Q_2/W_2$ = 17.5 ft^2/s

Bridge Vel, V_2 = 3 ft/s Final $y_2 = q_2/V_2$ = 5.9 ft Δh = 0.2 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 6.1 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. = 0.4-0.9 ft

Low Steel Elev. = 6.6 ft

n (Channel) = 0.040

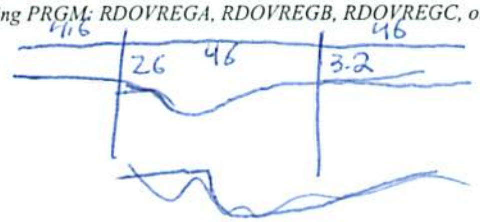
n (LOB) = 0.030

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 = 46 ft

Width of left overbank flow at approach, W_{lob} = 46 ft Average left overbank flow depth, y_{lob} = 3.1 2.6 ft

Width of right overbank flow at approach, W_{rob} = 46 ft Average right overbank flow depth, y_{rob} = 3.2 3.7 ft

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

x = 5.12 From Figure 9 W_2 (effective) = 44.4 ft y_{cs} = 5.8 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, $V_1 = Q_{100}/(y_1W_1)$ = ______ 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

PIER SCOUR CALCULATIONS

PGRM: Pier

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

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 2.6 ft right abutment, y_{aRT} = 3.2 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} = 10.6 and ψ_{RT} = 11.9

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 15.8 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 17.7 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 25410219 Date 7/18/12 Initials RaT Region (A B [✓ C] D)

Site ____ Location 2 mi N of Zell on 372nd Ave

Q_{500} = Q25 1570 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = ~~[illegible]~~ 971 (should be Q_{500} unless there is a relief bridge, road overflow, or bridge overtopping)

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

Analytical Procedure for Estimating Hydraulic Variables Needed to Apply Method

Bridge Width = 46 ft. Flow angle at bridge = 15 ° Abut. Skew = 0 ° Effective Skew = 15 °

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 = 44.43 ft* $q_2 = Q_2/W_2$ = 21.9 ft²/s

Bridge Vel, V_2 = 3.3 ft/s Final $y_2 = q_2/V_2$ = 6.6 ft Δh = 0.2 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 6.8 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. = 0.4-0.9 ft

Low Steel Elev. = 6.6 ft

n (Channel) = 0.040

n (LOB) = 0.030

n (ROB) = 0.030

Pier Width = – ft

Pier Length = – ft

Piers for 500 yr = – ft

CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 46 ft

Width of left overbank flow at approach, W_{lob} = 46 ft Average left overbank flow depth, y_{lob} = 3.4 ft

Width of right overbank flow at approach, W_{rob} = 46 ft Average right overbank flow depth, y_{rob} = 3.9 ft

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

x = 6.91 From Figure 9 W_2 (effective) = 44.4 ft y_{cs} = 7.7 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, $V_1 = Q_{500}/(y_1 W_1)$ = ____ ft/s

Critical approach velocity, $V_c = 11.17 y_1^{1/6} D_{50}^{1/3}$ = ____ 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

PIER SCOUR CALCULATIONS

PGRM: Pier

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

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 3.4 ft right abutment, y_{aRT} = 3.9 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} = 12.2 and ψ_{RT} = 13.1

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 18.2 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 19.5 ft

98° 44' 12.984"
44° 55' 36.984"

98.73694
44.92694

Route 372 Ave Stream Dove Ck MRM ______ Date 7/18/12 Initials Rat

Bridge Structure No. 25410219 Location 2 mi N of Zell on 372nd Ave

GPS coordinates: N 44° 55' 37.0" taken from: USL abutment X centerline of ⇑ MRM end ______

W 98° 44' 13.8" Datum of coordinates: WGS84 X NAD27 _____

Drainage area = 72.54 sq. mi.

The average bottom of the main channel was 11.6 ft below top of guardrail at a point 17 ft from left abutment.

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

MISCELLANEOUS CONSIDERATIONS

Flows	~~Q100~~ = Q10 776			~~Q500~~ = Q25 1570		
Estimated flow passing through bridge	776			~~776~~ 971		
Estimated road overflow & overtopping	0			599		
Consideration	Yes	No	Possibly	Yes	No	Possibly
Chance of overtopping		X		X		
Chance of Pressure flow		X		X		
Armored appearance to channel		X			X	
Lateral instability of channel		X			X	

7/3

8/23

2	92.5
5	386
10	776
25	1570
50	2400
100	3460
500	6960

Riprap at abutments? ____Yes X No ____Marginal

Evidence of past Scour? X Yes ____No ____Don't know minor contraction likely abutment (underwater)

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

1). Left OB
2). main channel
3). right OB
4). left ~~OB~~ abutment
5). right abutment
6). main channel

Summary of Results

	~~Q100~~ Q10	~~Q500~~ Q25
Bridge flow evaluated	776	971
Flow depth at left abutment (yaLT), in feet	2.6	3.4
Flow depth at right abutment (yaRT), in feet	3.2	3.9
Contraction scour depth (ycs), in feet	5.8	7.7
Pier scour depth (yps), in feet	N/A	N/A
Left abutment scour depth (yas), in feet	15.8	18.2
Right abutment scour depth (yas), in feet	17.7	19.5
1Flow angle of attack	15	15

See Comments/Diagram for justification where required