OK RJT

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 06170147 Date 5-16-12 Initials CW/RaT Region (A B C D) 5

Site _____ Location 0.3mi N of HWY 14 Bypass on Medary Ave

Q_{100} = 4350 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. ✓

Bridge discharge (Q_2) = 4350 (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 = 99 ft. Flow angle at bridge = ~~35~~ 35° Abut. Skew = 0 ° Effective Skew = ~~35~~ 35 °

Width (W_2) iteration = 76 85 95 84 91 89 88

Avg. flow depth at bridge, y_2 iteration = 12.5 11.8 11.1 11.9 11.4 11.5 11 60.3

Corrected channel width at bridge Section = W_2 times cos of flow angle = 72.99 ft* $q_2 = Q_2/W_2$ = ~~51.7~~ ft²/s

Bridge Vel, V_2 = 5.5 ft/s Final $y_2 = q_2/V_2$ = 11.0 ft Δh = 0.6 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = ~~11.6~~ 11.6 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. = 3.7 ft

Low Steel Elev. = 13.9 ft

n (Channel) = 0.045

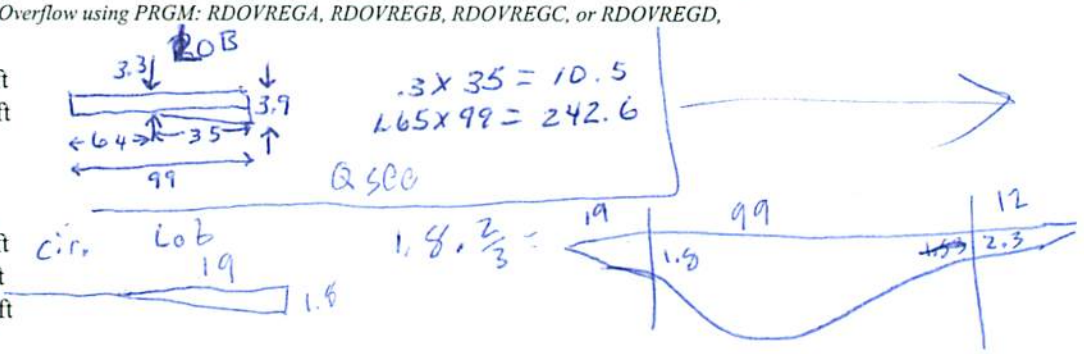
n (LOB) = 0.1

n (ROB) = 0.030

Pier Width = 1.5 ft

Pier Length = 1.5 ft

Piers for 100 yr = 1 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 99 ft

Width of left overbank flow at approach, W_{lob} = ~~99~~ 19 ft Average left overbank flow depth, y_{lob} = ~~3.6~~ 1.2 ft

Width of right overbank flow at approach, W_{rob} = 12 ft Average right overbank flow depth, y_{rob} = 1.53 ft

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

x = ~~1.79~~ 4.8 From Figure 9 W_2 (effective) = ~~85~~ 70.6 ft y_{cs} = ~~2.3~~ 5.5 ft

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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

PIER SCOUR CALCULATIONS

PGRM: Pier

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

Froude # at bridge = 0.29 Using pier width a on Figure 11, ξ = 6.4 Pier scour y_{ps} = 5.3 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 1.2 ft right abutment, y_{aRT} = 1.53 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} = 5.1 and ψ_{RT} = 6.4

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = ~~5.1~~ ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 6.4 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 06170147 Date _____ Initials _____ Region (A B (C) D)

Site _____ Location 0.3 mi N of HWY 14 Bypass on Meday Ave

Q_{500} = 6830 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 6830 (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 = 99 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 = 81.1 ft* $q_2 = Q_2/W_2$ = 84.2 ft²/s

Bridge Vel, V_2 = 6.5 ft/s Final $y_2 = q_2/V_2$ = 12.9 ft Δh = 0.9 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 13.8 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. = 3.7 ft

Low Steel Elev. = 13.9 ft

n (Channel) = 0.045

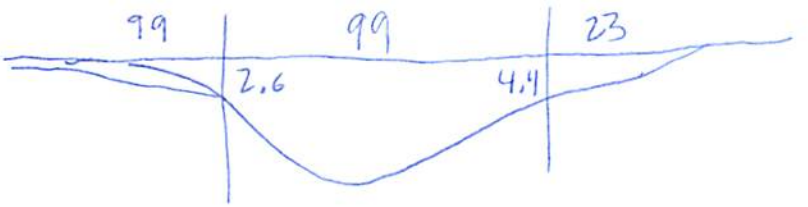
n (LOB) = 0.1

n (ROB) = 0.030

Pier Width = 1.5 ft

Pier Length = 1.3 ft

Piers for 500 yr = 1 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 99 ft 93.9

Width of left overbank flow at approach, W_{lob} = 99 ft Average left overbank flow depth, y_{lob} = 2.6 ft

Width of right overbank flow at approach, W_{rob} = 23 ft Average right overbank flow depth, y_{rob} = 2.93 ft

4.4 · ⅔

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

x = ~~0.97~~ 4.29 From Figure 9 W_2 (effective) = ~~97.5~~ 79.6 ft y_{cs} = ~~1.4~~ 4.9 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, $\chi = 0.122y_1[q_2/(D_{50}^{1/3}y_1^{7/6})]^{0.7} - y_1$ = _____ From Figure 10, y_{cs} = _____ ft

PIER SCOUR CALCULATIONS

PGRM: Pier

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

Froude # at bridge = 0.32 Using pier width a on Figure 11, ξ = 6.4 Pier scour y_{ps} = 5.4 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 2.6 ft right abutment, y_{aRT} = 2.93 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} = 11.4

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 10.6 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 11.4 ft

Route Medary Ave Stream Six Mile Ck MRM _____ Date _____ Initials _____

Bridge Structure No. 06170147 Location 0.3 mi N of HWY 14 Bypass on Medary Ave

GPS coordinates: N 40° 19' 50.57" taken from: USL abutment X centerline of ↑↓ MRM end _____

W96° 47' 17.21" Datum of coordinates: WGS84 X NAD27 _____

Drainage area = 71.5 sq. mi.

The average bottom of the main channel was 17.6 ft below top of guardrail at a point 27 ft from left abutment.

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

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2	84.8
5	224
10	353
25	553
50	724
100	910
500	1390

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} = 4350			Q_{500} = 6830		
Estimated flow passing through bridge		~~4350~~ 4350		6830		
Estimated road overflow & overtopping		0		0		
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	

5/14

2	395
5	1030
10	1630
25	2580
50	3420
100	4350
500	6830

Riprap at abutments? X Yes ____No ____Marginal

Evidence of past Scour? X Yes ____No ____Don't know - pier scour

Debris Potential? ____High X Med ____Low

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

Riprap	X Yes	____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

2260 Str. no.
2261 LOB from bridge
2262 approach from bridge
2263 ROB from bridge
2264 LOB / riprap in ditch, scour hole
2265 Left abut from approach
2266 right abut from approach

2267 bridge section from approach

Summary of Results

	Q100	Q500
Bridge flow evaluated	4350	6530
Flow depth at left abutment (yaLT), in feet	1.2	2.6
Flow depth at right abutment (yaRT), in feet	1.53	2.93
Contraction scour depth (ycs), in feet	~~2.3~~ 5.5	~~4.4~~ 4.9
Pier scour depth (yps), in feet	5.3	5.4
Left abutment scour depth (yas), in feet	5.1	~~2.6~~ 10.6
Right abutment scour depth (yas), in feet	6.4	~~2.93~~ 11.4
1Flow angle of attack	350	350

See Comments/Diagram for justification where required