OK RT

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 34200171 Date 6/6/12 Initials RaT Region (A B C D)

Site _____ Location 2mi W & 1mi N of Olivet on 424 Ave

Q_{100} = 1660 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 1660 (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

Bridge Width = 62 ft. Flow angle at bridge = 5 ° Abut. Skew = 0 ° Effective Skew = 5 °

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 = 61.76 ft* $q_2 = Q_2/W_2$ = 27.2 ft^2/s

Bridge Vel, V_2 = 3.7 ft/s Final $y_2 = q_2/V_2$ = 7.4 ft Δh = 0.3 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 7.6 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,

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

Water Surface Elev. = 1.5 ft

Low Steel Elev. = 8.4 ft

n (Channel) = 0.035

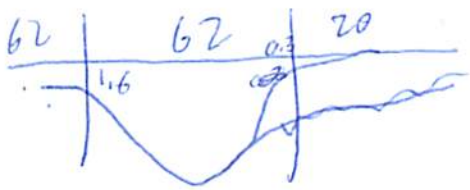
n (LOB) = 0.035

n (ROB) = 0.035

Pier Width = 2.5 ft

Pier Length = 130 ft

Piers for 100 yr = 3 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 62 ft

Width of left overbank flow at approach, W_{lob} = 62 ft Average left overbank flow depth, y_{lob} = 1.6 ft

Width of right overbank flow at approach, W_{rob} = 62 20 ft Average right overbank flow depth, y_{rob} = 0.3 ft

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

x = 1.74 From Figure 9 W_2 (effective) = 54.3 ft y_{cs} = 2.3 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

PGRM: Pier

PIER SCOUR CALCULATIONS

L/a ratio = 52 Correction factor for flow angle of attack (from Table 1), K2 = 1.5

Froude # at bridge = 0.24 Using pier width a on Figure 11, ξ = 9.5 Pier scour y_{ps} = 11.5 ft

PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, y_{aLT} = 1.6 ft right abutment, y_{aRT} = 0.3 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} = 6.6 and ψ_{RT} = 1.4

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 12.1 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 2.6 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 34200171 Date 6/6/12 Initials RaT Region (A B C D)

Site _____ Location 2 mi W of I mi N of Olivet on 424 Ave

Q_{500} = 3150 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 2148 (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 = 62 ft. Flow angle at bridge = 5 ° Abut. Skew = 0 ° Effective Skew = 5 °

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 = 61.76 ft* $q_2 = Q_2/W_2$ = 35.4 ft²/s

Bridge Vel, V_2 = 4.2 ft/s Final $y_2 = q_2/V_2$ = 8.4 ft Δh = 0.4 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 8.8 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. = 1.5 ft

Low Steel Elev. = 8.4 ft

n (Channel) = 0.035

n (LOB) = 0.035

n (ROB) = 0.035

Pier Width = 2.5 ft

Pier Length = 130 ft

Piers for 500 yr = 3 ft

CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 62 ft

Width of left overbank flow at approach, W_{lob} = ~~62~~ 62 ft Average left overbank flow depth, y_{lob} = 2.8 ft

Width of right overbank flow at approach, W_{rob} = 62 ft Average right overbank flow depth, y_{rob} = 1.6 ft

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

x = 3.33 From Figure 9 W_2 (effective) = 54.3 ft y_{cs} = 3.9 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, $V_1 = Q_{500}/(y_1 W_1)$ = _____ 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 = 52 Correction factor for flow angle of attack (from Table 1), K2 = 1.5

Froude # at bridge = ~~0.26~~ 0.26 Using pier width a on Figure 11, ξ = 9.5 Pier scour y_{ps} = 11.7 ft

PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, y_{aLT} = 2.8 ft right abutment, y_{aRT} = 1.6 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} = 11.2 and ψ_{RT} = 6.6

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 20.3 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 12.1 ft

97.7176
43.25534

77° 43' 3.5"
43° 15' 19.2"

Route 424 Ave Stream Loneree Ck MRM _____ Date 6/6/12 Initials RJT

Bridge Structure No. 34200171 Location 2 mi W & 1 mi N of Olivet on 424 Ave

GPS coordinates: N 43° 15' 19.1" taken from: USL abutment X centerline of ⇑ MRM end _____

W 97° 43' 4.3" Datum of coordinates: WGS84 X NAD27 _____

Drainage area = 48.92 sq. mi.

The average bottom of the main channel was 9.2 ft below top of guardrail at a point 24 ft from left abutment.

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

8/24

2	103
5	388
10	754
25	1490
50	2260
100	3240
500	6530

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} = 1640			Q_{500} = 3180		
Estimated flow passing through bridge	1640			2188		
Estimated road overflow & overtopping	0			992		
Consideration	Yes	No	Possibly	Yes	No	Possibly
Chance of overtopping		X			X	
Chance of Pressure flow		X				?
Armored appearance to channel		X			X	
Lateral instability of channel		X			X	

5/26

2	64.1
5	222
10	415
25	786
50	1160
100	1640
500	3150

Riprap at abutments? X Yes ____No ____Marginal on downstream side only

Evidence of past Scour? ____Yes X No ____Don't know

Debris Potential? ____High ____Med X Low

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

Riprap	X Yes	____No	____Don't know	____NA rosequartz downstream.
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). main channel
2). left abutment
3). right abutment
4). main channel
5). right OB
6). left OB

Summary of Results

	Q100	Q500
Bridge flow evaluated	1640	2188
Flow depth at left abutment (yaLT), in feet	1.6	2.8
Flow depth at right abutment (yaRT), in feet	0.3	1.6
Contraction scour depth (ycs), in feet	2.3	3.9
Pier scour depth (yps), in feet	11.5	11.7
Left abutment scour depth (yas), in feet	12.1	20.3
Right abutment scour depth (yas), in feet	2.6	12.1
1Flow angle of attack	5	5

See Comments/Diagram for justification where required