DUP ok-RAT

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 526082 98 Date 9-20-12 Initials RFT Region (A (B) C D)

Site _____ Location 0.3 mi S of New Underwood on 161 Ave

Q_{100} = 152 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. U

Bridge discharge (Q_2) = 152 (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 = 50 ft. Flow angle at bridge = 0 ° Abut. Skew = 0 ° Effective Skew = 0 °

Width (W_2) iteration = 32 47 43 _____

Avg. flow depth at bridge, y_2 iteration = 2.4 2.0 2.1 _____

Corrected channel width at bridge Section = W_2 times cos of flow angle = 43 ft* $q_2 = Q_2/W_2$ = 3.5 ft^2/s

Bridge Vel, V_2 = 1.7 ft/s Final $y_2 = q_2/V_2$ = 2.1 ft Δh = 0.1 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 2.2 ft

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

* *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.

this bridge is "large" for its drainage area. It may act as a relief bridge for Boxelder Cr?

Water Surface Elev. = _____ ft

Low Steel Elev. = 5.8 ft

n (Channel) = .035 — pasture w/grassed channel

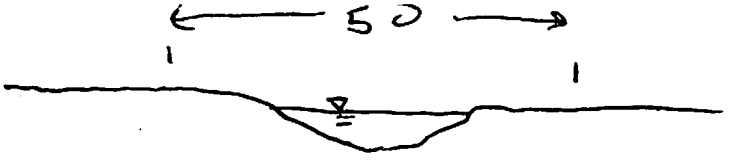
n (LOB) = .030 > pasture

n (ROB) = .030

Pier Width = NA ft

Pier Length = NA ft

Piers for 100 yr = 0 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 50 ft

Width of left overbank flow at approach, W_{lob} = 0 ft Average left overbank flow depth, y_{lob} = 0 ft

Width of right overbank flow at approach, W_{rob} = 0 ft Average right overbank flow depth, y_{rob} = 0 ft

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

x = _____ From Figure 9 W_2 (effective) = _____ ft y_{cs} = _____ ft

PGRM: CWCSNEW

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

Estimated bed material D_{50} = 0.3 ft Average approach velocity, $V_1 = Q_{100}/(y_1 W_1)$ = 1.38 ft/s

Critical approach velocity, $Vc = 11.17 y_1^{1/6} D_{50}^{1/3}$ = 8.53 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.

$D_{c50} = 0.0006(q_2/y_1^{7/6})^3$ = 0.002 ft If $D_{50} >= D_{c50}$, χ = 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} = 0 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} = 0 ft right abutment, y_{aRT} = 0 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} = 0 and ψ_{RT} = 0

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 0 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 0 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 526 08298 Date _____ Initials _____ Region (A (B) C D)

Site _____ Location _____

Q_{500} = 271 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. ✓

Bridge discharge (Q_2) = 271 (should be Q_{500} unless there is a relief bridge, road overflow, or bridge overtopping)

24 23

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

Analytical Procedure for Estimating Hydraulic Variables Needed to Apply Method

Bridge Width = 50 ft. Flow angle at bridge = 0 ° Abut. Skew = 0 ° Effective Skew = 0 °

Width (W_2) iteration = 50 47 ~~48~~ _____

Avg. flow depth at bridge, y_2 iteration = 2.6 2.7 _____ _____

Corrected channel width at bridge Section = W_2 times cos of flow angle = 47 ft* $q_2 = Q_2/W_2$ = 5.8 ft²/s

Bridge Vel, V_2 = 2.1 ft/s Final $y_2 = q_2/V_2$ = 2.7 ft Δh = 0.1 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 2.8 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. = dry ft

Low Steel Elev. = 5.8 ft

n (Channel) = .035

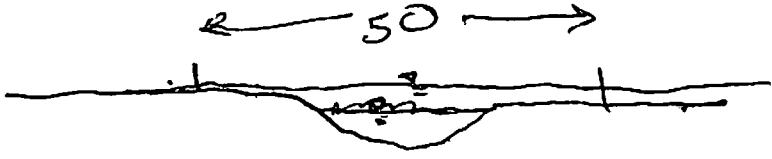
n (LOB) = .030

n (ROB) = .030

Pier Width = NA ft

Pier Length = NA ft

Piers for 500 yr = 0 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 50 ft

Width of left overbank flow at approach, W_{lob} = 10 ft Average left overbank flow depth, y_{lob} = 0.1 ft

Width of right overbank flow at approach, W_{rob} = 40 ft Average right overbank flow depth, y_{rob} = 0.2 ft

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

x = _____ From Figure 9 W_2 (effective) = _____ ft y_{cs} = _____ ft

PGRM: CWCSNEW

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

Estimated bed material D_{50} = 0.3 ft Average approach velocity, $V_1 = Q_{500}/(y_1 W_1)$ = 0.97 ft/s

Critical approach velocity, $Vc = 11.17 y_1^{1/6} D_{50}^{1/3}$ = 8.88 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.

$D_{c50} = 0.0006(q_2/y_1^{7/6})^3$ = .003 ft If $D_{50} >= D_{c50}$, χ = 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} = 0 ft

PGRM: Pie

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} = 0.1 ft right abutment, y_{aRT} = 0.2 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} = 0.5 and ψ_{RT} = 1

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 0.5 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 1 ft

Route 161 Ave Stream _____ MRM _____ Date _____ Initials _____

Bridge Structure No. 52608298 Location 0.3 mi S New Underwood on 161 Ave

GPS coordinates: N 44° 05.086' taken from: USL abutment ✓ centerline of ⇑ MRM end _____

W 102° 50.036' Datum of coordinates: WGS84 ✓ NAD27 _____

Drainage area = 0.2 sq. mi.

The average bottom of the main channel was 10.3 ft below top of guardrail at a point 14 ft from left abutment.

Method used to determine flood flows: ___Freq. Anal. ___drainage area ratio ✓regional regression equations.

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} = 152			Q_{500} = 271		
Estimated flow passing through bridge	152			271		
Estimated road overflow & overtopping	0			0		
Consideration	Yes	No	Possibly	Yes	No	Possibly
Chance of overtopping		✓			✓	
Chance of Pressure flow		✓			✓	
Armored appearance to channel		✓			✓	
Lateral instability of channel		✓			✓	

Riprap at abutments? X Yes ___No ___Marginal riprap on abutments and channel under bridge and in up- and down-stream ditches

Evidence of past Scour? ___Yes X No ___Don't know

Debris Potential? ___High ___Med X Low ← a few trees upstream, but no piers

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

Riprap	✓Yes	___No	___Don't know	___NA
Spur Dike	___Yes	___No	___Don't know	___NA
Other _____	___Yes	___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

because of riprap, assume cwcs

Comments, Diagrams & orientation of digital photos

str, no.

approach from bridge

LOB from bridge

ROB from bridge

Bridge from near rt abut

under bridge

Summary of Results

	Q100	Q500
Bridge flow evaluated	152	271
Flow depth at left abutment (yaLT), in feet	0	0.1
Flow depth at right abutment (yaRT), in feet	0	0.2
Contraction scour depth (ycs), in feet	0	0
Pier scour depth (yps), in feet	NA	NA
Left abutment scour depth (yas), in feet	0	0.5
Right abutment scour depth (yas), in feet	0	1.0
Flow angle of attack	0°	0°

See Comments/Diagram for justification where required