Ok TCT

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 20170249 Date 5-18-12 Initials CW/RaT Region (A B C D)

Site _____ Location 4 mi N of Astoria on 483 Ave

Q_{100} = 2260 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. ✓

Bridge discharge (Q_2) = 2260 (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 = 108 ft. Flow angle at bridge = 10 ° Abut. Skew = 0 ° Effective Skew = 10 °

Width (W_2) iteration = ~~106.36~~ 104 ____ ____

Avg. flow depth at bridge, y_2 iteration = ~~6.5~~ 6.5 ____ ____

Corrected channel width at bridge Section = W_2 times cos of flow angle = 106.36 ft* $q_2 = Q_2/W_2$ = 21.2 ft^2/s

Bridge Vel, V_2 = 3.3 ft/s Final $y_2 = q_2/V_2$ = 6.5 ft Δh = 0.2 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 6.7 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,

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

Water Surface Elev. = 0 ft

Low Steel Elev. = ~~13~~ 10 ft

n (Channel) = 0.090

n (LOB) = 0.075

n (ROB) = 0.075

Pier Width = 1.7 ft

Pier Length = 1.7 ft

Piers for 100 yr = 4 ft

CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 136 ft (3.5 + 4.8)/2 =

Width of left overbank flow at approach, W_{lob} = 108 ft Average left overbank flow depth, y_{lob} = 4.2 ft

Width of right overbank flow at approach, W_{rob} = 104 ft Average right overbank flow depth, y_{rob} = 5.2 ft

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

x = ~~12.17~~ 12.8 From Figure 9 W_2 (effective) = 99.6 ft y_{cs} = ~~13.3~~ 11.77 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 = 1 Correction factor for flow angle of attack (from Table 1), K2 = 1

Froude # at bridge = 0.23 Using pier width a on Figure 11, ξ = 7 Pier scour y_{ps} = 5.6 ft

PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, y_{aLT} = 4.2 ft right abutment, y_{aRT} = 5.2 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} = 13.6 and ψ_{RT} = 15.4

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 13.6 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 15.4 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 20170249 Date _____ Initials _____ Region (A B C D)

Site _____ Location 4 mi N of Astoria on 483 Ave

Q_{500} = 3520 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. ✓

Bridge discharge (Q_2) = 3520 (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 = ~~130~~ 104 ft. Flow angle at bridge = 10 ° Abut. Skew = 0 ° Effective Skew = 10 °

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 = 106.36 ft* $q_2 = Q_2/W_2$ = 33.1 ft^2/s

Bridge Vel, V_2 = 4.1 ft/s Final $y_2 = q_2/V_2$ = 8.1 ft Δh = 0.3 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 8.5 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. = ~~9.5~~ 10 ft

n (Channel) = 0.90

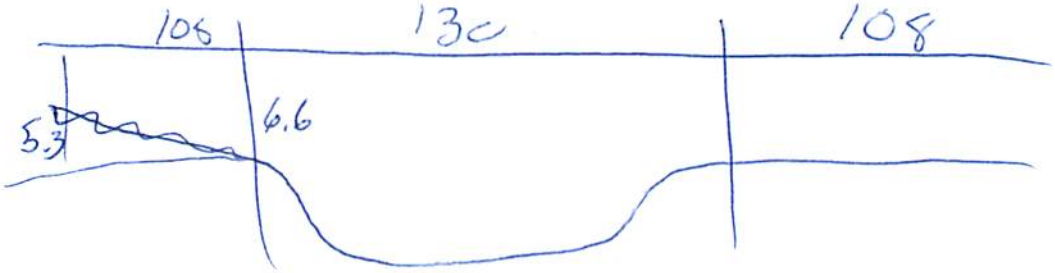
n (LOB) = 0.075

n (ROB) = 0.075

Pier Width = 1.7 ft

Pier Length = 1.7 ft

Piers for 500 yr = 4 ft



CONTRACTION SCOUR

PGRM: Contract

20+ Bridge

Width of main channel at approach section W_1 = 130 ft

Width of left overbank flow at approach, W_{lob} = 108 ft

Width of right overbank flow at approach, W_{rob} = 106 ft

(5.3 + 6.6)/2 =

Average left overbank flow depth, y_{lob} = 6.1 ft

~~(3.5+4.4)/2 =~~

Average right overbank flow depth, y_{rob} = 7.0 ft

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

x = 16.97 From Figure 9 W_2 (effective) = 99.6 ft y_{cs} = 16.1 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

PIER SCOUR CALCULATIONS

PGRM: Pier

L/a ratio = 1.0 Correction factor for flow angle of attack (from Table 1), K2 = 1.0

Froude # at bridge = 0.25 Using pier width a on Figure 11, ξ = 7 Pier scour y_{ps} = 5.7 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 6.1 ft right abutment, y_{aRT} = 7.0 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} = 17 and ψ_{RT} = 18.6

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 17 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 18.6 ft

3.5
4.6/3
4.

4 1

Route 483 Ave Stream Cobb Ck MRM _____ Date _____ Initials Ch/RAT

Bridge Structure No. 20170249 Location 4 mi N of Astoria on 483 Ave

GPS coordinates: N 46°37'0.7" W 46°32'29" taken from: USL abutment X centerline of ↑ MRM end _____

Datum of coordinates: WGS84 X NAD27 _____

Drainage area = 22.15 sq. mi.

The average bottom of the main channel was 13.7 ft below top of guardrail at a point 25 ft from left abutment.

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

8/23

2	204
5	539
10	853
25	1350
50	1780
100	2260
500	3520

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} = 2260			Q_{500} = 3520		
Estimated flow passing through bridge	2260			3520		
Estimated road overflow & overtopping						
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	

Riprap at abutments? ____Yes X No ____Marginal

Evidence of past Scour? X Yes ____No ____Don't know Pier

Debris Potential? X High ____Med ____Low

5/17

2	204
5	540
10	854
25	1350
50	1780
100	2266
500	3520

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

Riprap	____Yes	____No	____Don't know	X NA
Spur Dike	____Yes	____No	____Don't know	X NA
Other _____	____Yes	____No	____Don't know	X 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

2327 Str. no.
2328 approach from bridge
2329 ROB from bridge
2330 LOB from bridge
2331 rt. abut. from ditch
2332 under bridge
2333 left abut. from rt. abut.
2334 rt. abut. from rt. approach
2335 bridge from channel at approach
2336 left abut. from rt approach

Summary of Results

	Q100	Q500
Bridge flow evaluated	2260	3520
Flow depth at left abutment (yaLT), in feet	4.2	6.1
Flow depth at right abutment (yaRT), in feet	~~5.2~~ 5.2	7.0
Contraction scour depth (ycs), in feet	~~13~~ ~~13.3~~ 12.8	16.1
Pier scour depth (yps), in feet	5.6	5.7
Left abutment scour depth (yas), in feet	13.6	17
Right abutment scour depth (yas), in feet	15.4	18.6
1Flow angle of attack	10	10

See Comments/Diagram for justification where required