OHIO DEPARTMENT OF TRANSPORTATION

PLANNING & ENGINEERING DEPARTMENT, DISTRICT 4

Project POR-5/VAR-5.09/VAR — Calc By KB — Date 07/26/22

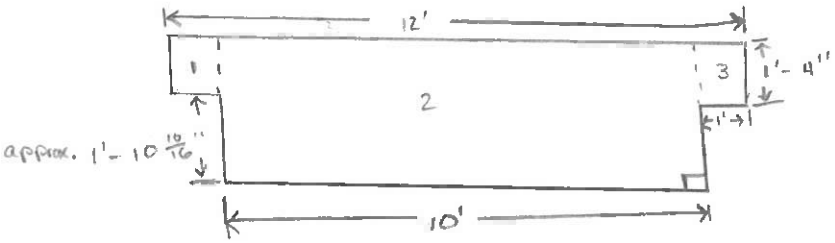
Desc Seal all exposed surfaces of headwalls and wingwalls for structure POR-5-0590 and POR-5-1171 — Chk By ____ — Date ____

PID/PROJ 110672

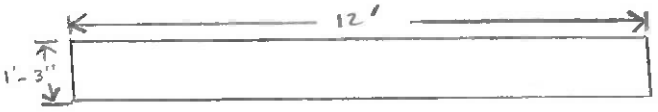
1 of 40

POR-5-0590

Face of headwall (typical)



Top of head wall (typical)



Area: $A = 12ft \cdot \left(1ft \frac{3in}{12\frac{in}{ft}}\right) = 15ft^2$

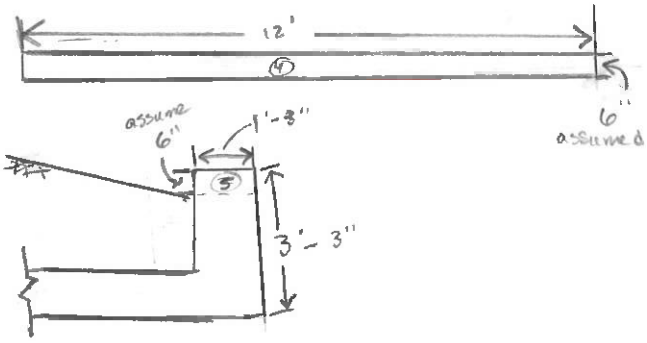
Area 1&3: $A_{1\&3} = 1ft \cdot 1ft \frac{4in}{12\frac{in}{ft}} = 1.33ft^2$ (2)

$= 2.66ft^2$

Area 2: $A_2 = 10ft \cdot \left(1ft \frac{4in}{12\frac{in}{ft}} + 1ft \frac{10\frac{10}{16}in}{12\frac{in}{ft}}\right) = 32.187ft^2$

$\Sigma A_{face} = 32.187 + 2.66ft^2 = 34.85ft^2 \approx 35\ ft^2$

Back and side of headwall



$A_4 = 12ft \cdot \left(\frac{6in}{12\frac{in}{ft}}\right) = 6\ ft^2$

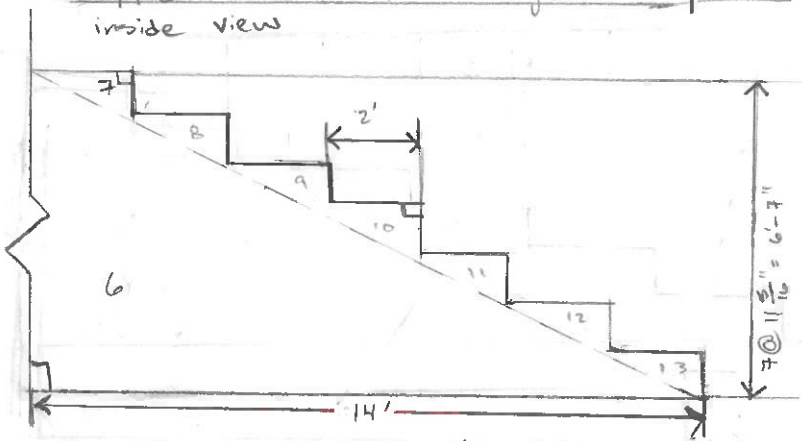
$A_5 = \left(1ft \frac{3in}{12\frac{in}{ft}}\right) \cdot \left(\frac{6in}{12\frac{in}{ft}}\right) = 0.625ft^2$

$\Sigma A_{headwall} = 34.85ft^2 + 15ft^2 + 6ft^2 + 0.625ft^2$

$= 56.475\ ft^2$

Stepped Face and Top of wingwall (typical)

inside view



ΣA of Front face $= 0.942ft^2$ (7)

$= 6.598\ ft^2$

ΣA of top view $= 2.0ft^2$ (7)

$= 14\ ft^2$

Front Face view: $A = \left(11\frac{5}{16}in\right)\left(\frac{1ft}{12\frac{in}{ft}}\right) = 0.942ft^2$

Top view: $A = 1ft\ (2ft)$

$= 2ft^2$

see page 2 to see area of bottom of inside face

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Stepped Wingwall inside face (typical)

$A_6 = \frac{1}{2}(14ft)(6ft + \frac{7in}{12\frac{in}{ft}})$

$= 46.083ft^2$

$A_7 = \frac{1}{2}(2ft)(11\frac{5}{16}in \div 12\frac{in}{ft})$

$= 0.9427ft^2$

$\Sigma A_{7-13} = (0.9427ft^2)(7)$

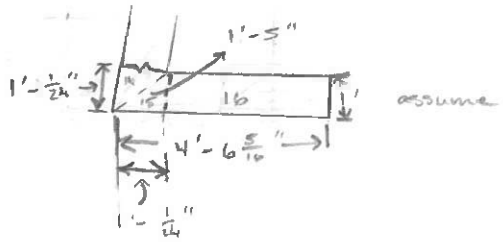
$= 6.598ft^2$

$\Sigma A_{wingwall\ inside} = 46.083ft^2 + 6.598ft^2$

$= 52.6822\ ft^2$

Wingwall End section (typical)

Top view of End section



$A_{14\&15} = \frac{1}{2}(1ft + \frac{1}{24}in \div 12\frac{in}{ft})(1ft)(2)$

$= 1.0034ft^2$

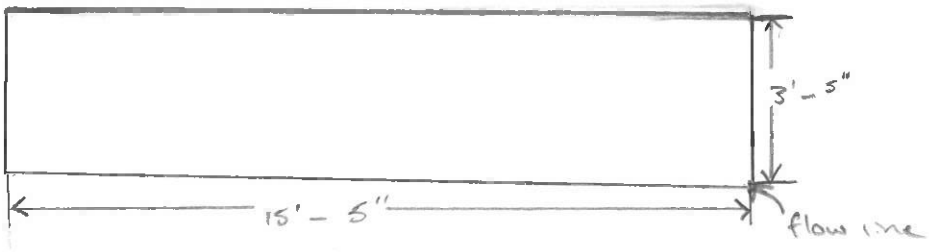
$A_{16} = (4'-6\frac{5}{16}" - 1'-\frac{1}{24}")\cdot(1ft)$

$= 3.522ft^2$

$\Sigma A_{14-16} = 1.0034ft^2 + 3.55ft^2$

$= 4.52896ft^2$

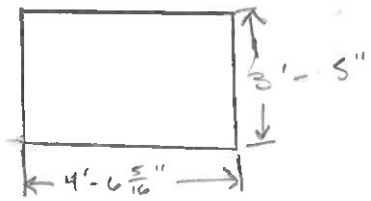
Inside face bottom of step of wingwall (typical)



$A = (15ft \frac{5in}{12\frac{in}{ft}})(3ft \frac{5in}{12\frac{in}{ft}})$

$= 52.63ft^2$

Face view of End section of Wingwall (typical)



$A = (4ft \frac{6\frac{5}{16}in}{12\frac{in}{ft}})(3ft \frac{5in}{12\frac{in}{ft}})$

$= 15.4639ft^2$

Back of w.g wall (typical)

assume 6" width $l = 4'-6\frac{5}{16}"$

$A = (4ft \frac{6\frac{5}{16}in}{12\frac{in}{ft}})(\frac{6in}{12\frac{in}{ft}})$

$= 2.263ft^2$

$\Sigma_{wingwall\ (outside)} = 6.598ft^2 + 14ft^2 + 52.6822ft^2 + 52.63ft^2 + 4.53ft^2 + 15.46ft^2 + 2.263ft^2$

$= 148.15\ ft^2$

OHIO DEPARTMENT OF TRANSPORTATION

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Project **POR-5/VAR-5.09/VAR** Calc By **KB** Date **07/26/22**

Desc **Seal all exposed surfaces of headwalls and wingwalls for structure POR-5-0590 and POR-5-1171** Chk By ____ Date ____

PID/PROJ **110672**

Barrel of Culvert box

Assume width = 2'-0" per Detail I

Top and bottom Area

ℓ = 10'-0" per headwall detail on Pg. 1

$A = (10')(2')(2)$

$= 40 ft^2$

Sides Area

ℓ = 8'-0" per original plans

$A = (8')(2')(2)$

$= 32 ft^2$

Σ Barrel = $40 ft^2 + 32 ft^2 = 72 ft^2$

Area per side

Σ headwall = $56.475 ft^2$

Σ Barrel of Culvert = $72 ft^2$

Σ wingwall = $148.15 ft^2 (2)$

$= 296.3 ft^2$

$\Sigma A_{per\ side} = 424.775 ft^2$

Total Area = Σ Area per side (2)

$= 420.745 ft^2 (2)$

$= 849.55 ft^2 \left(\frac{1\ yd^2}{9\ ft^2}\right)$

$= 94.394\ yd^2$

Total Area $\approx 95 yd^2$

OHIO DEPARTMENT OF TRANSPORTATION

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PID/PROJ 110672

Area of inside face of wingwall (one side)

$A_{of\ 8-10} = \frac{1}{2}\left(1' - \frac{3''}{12\frac{in}{ft}}\right)\left(2' - \frac{8''}{12\frac{in}{ft}}\right)(3)$

$= 5SF$

$A_{of\ 11} = \frac{1}{2}(8')\left(3' - \frac{9''}{12\frac{in}{ft}}\right)$

$= 15SF$

$A_{of\ 12} = (8')\left(3' - \frac{10''}{12\frac{in}{ft}}\right)$

$= 30.66\ SF$

$A_{of\ 13} = \left(1' - \frac{7''}{12\frac{in}{ft}}\right)\left(3' - \frac{10''}{12\frac{in}{ft}}\right)$

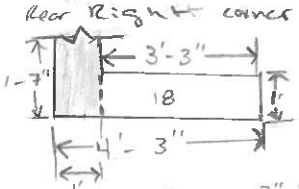
$= 6.069\ SF$

$\Sigma A_{8-13} = 5SF + 15SF + 30.66SF + 6.069SF$

$= 56.736\ SF$

Wingwall End Section Top View

Rear Right corner

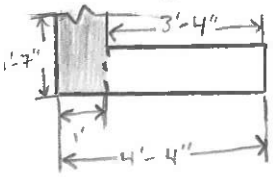


shaded area already accounted for on page 4

$A_{18} = (1')\left(3' - \frac{3''}{12\frac{in}{ft}}\right)$

$= 3.25\ SF$

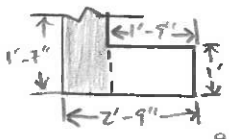
Forward Right corner



$A = (1')\left(3' - \frac{4''}{12\frac{in}{ft}}\right)$

$= 3.33\ SF$

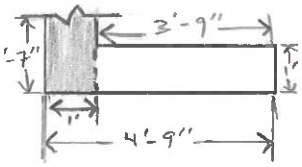
Forward left corner



$A = (1')\left(1' - \frac{9''}{12\frac{in}{ft}}\right)$

$= 1.75SF$

Rear left corner

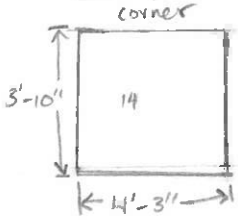


$A = (1')\left(3' - \frac{9''}{12\frac{in}{ft}}\right)$

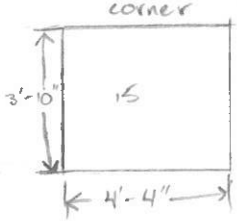
$= 3.75SF$

Wingwall End Section-Faces

Rear Right corner



Forward Right corner



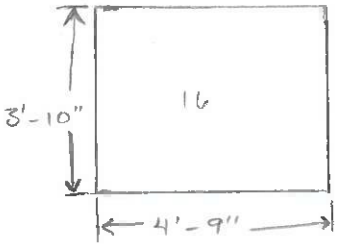
$A = \left(3' - \frac{10''}{12\frac{in}{ft}}\right)\left(4' - \frac{4''}{12\frac{in}{ft}}\right)$

$= 16.61\ SF$

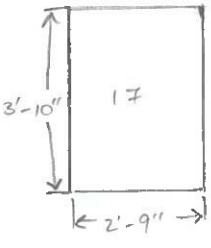
$A = \left(3' - \frac{10''}{12\frac{in}{ft}}\right)\left(4' - \frac{3''}{12\frac{in}{ft}}\right)$

$= 16.2916\ SF$

Rear left corner



Forward left corner



$A = \left(3' - \frac{10''}{12\frac{in}{ft}}\right)\left(2' - \frac{9''}{12\frac{in}{ft}}\right)$

$= 10.5416\ SF$

$A = \left(3' - \frac{10''}{12\frac{in}{ft}}\right)\left(4' - \frac{9''}{12\frac{in}{ft}}\right)$

$= 18.2083\ SF$

$\Sigma A = 16.29SF + 16.61SF + 18.21SF + 10.54SF$

$= 61.65\ SF$

Wingwall End Section back side

assume $w = 6''$ and using lengths above:

$A_{14} = \left(\frac{6''}{12\frac{in}{ft}}\right)\left(4' - \frac{3''}{12\frac{in}{ft}}\right)$

$= 2.125\ SF$

$A_{15} = \left(\frac{6''}{12\frac{in}{ft}}\right)\left(4' - \frac{4''}{12\frac{in}{ft}}\right)$

$= 2.166\ SF$

$A_{16} = \left(\frac{6''}{12\frac{in}{ft}}\right)\left(4' - \frac{9''}{12\frac{in}{ft}}\right)$

$= 2.375\ SF$

$A_{17} = \left(\frac{6''}{12\frac{in}{ft}}\right)\left(2' - \frac{9''}{12\frac{in}{ft}}\right)$

$= 1.375\ SF$

$\Sigma A = 2.125SF + 2.166SF + 2.375SF + 1.375SF$

$= 8.035\ SF$

Top views Sum:

$\Sigma A = 3.25SF + 3.33SF + 3.75SF + 1.75SF$

$= 12.0833\ SF$

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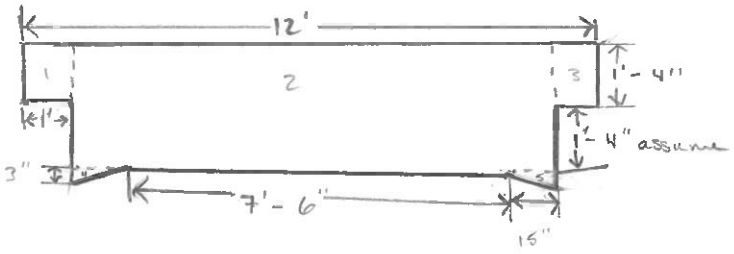
Scale 1:40

POR-5-1171

Face of headwall



$A_{1\&3} = 1'\left(1' - \left(\frac{4''}{12\frac{in}{Ft}}\right)\right)(2) = \frac{8}{3}$ SF

$A_2 = 10'\left(2' - \frac{8''}{12\frac{in}{Ft}}\right)$

$= 26.66$ SF

$A_{4\&5} = \frac{1}{2}\left(\frac{3in}{12\frac{in}{Ft}}\right)\left(\frac{15in}{12\frac{in}{Ft}}\right)(2) = 0.3125$ SF

Top of headwall

$A = 12'\left(1' - \frac{3''}{12\frac{in}{Ft}}\right)$

$= 15$ SF

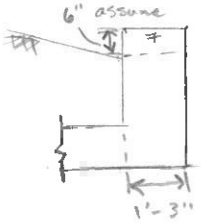
Back of headwall

$A = (12')\left(\frac{6''}{12\frac{in}{Ft}}\right)$

$A_6 = 6$SF

$A_7 = \left(\frac{6''}{12\frac{in}{Ft}}\right)\left(1' - \frac{3in}{12\frac{in}{Ft}}\right)$

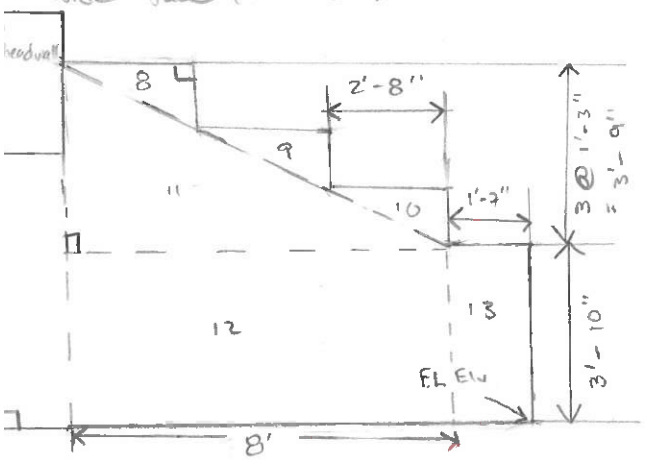
$= 0.625$ SF



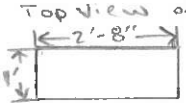
$\sum A_{headwall} = \frac{8}{3}$ SF $+ 26.665$SF 0.3125 SF $+ 15$SF $+ 6$SF $+ 0.625$SF $= 51.2708$ SF

Stepped Wing Wall

Inside face (one side)



Top view of step



$A_{of1} = (1')\left(2' - \frac{8''}{12\frac{in}{Ft}}\right)$

$= 2.666$ SF

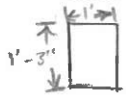
top view of bottom step

$A_{of1} = (1')\left(1' - \frac{7''}{12\frac{in}{Ft}}\right)$

$= 1.5833$SF

$\sum A = 3(2.666SF) + 1.583SF = 9.5838$SF

Face view of step



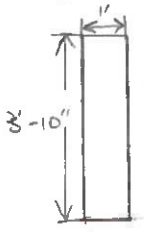
$A_{of1} = (1')\left(1' - \frac{3''}{12\frac{in}{Ft}}\right)$

$= 1.25$ SF

$\sum A = 3(1.25SF) + 3.8333SF$

$= 7.5883$ SF

Face view of bottom step



$A = (1')\left(3' - \frac{10''}{12\frac{in}{Ft}}\right)$

$= 3.8333$SF

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Barrel of Culvert Box

Assume Width = 2'-0" per Detail I

Top and Bottom Area

ℓ = 10'-0" per Typical Section on original Bridge Plan

$A = (10')(2')(2)$

$= 40\,SF$

Sides Area

ℓ = 6'-0" per typical section on original Bridge Plan

$A = (6')(2')(2)$

$= 24\,SF$

$\Sigma A_{Barrel} = 40SF + 24SF = 64SF$

Area Totals

$\Sigma A_{headwall} = 51.2708\,SF\,(2) = 102.5416\,SF$

$\Sigma A_{barrel} = 64\,SF$

$\Sigma A_{wingwall\,side} = 56.736\,SF\,(4) = 226.944\,SF$

$\Sigma A_{wingwall\,face} = 61.655F$

$\Sigma A_{wingwall\,backside} = 8.03555F$

$\Sigma A_{wingwall\,top} = 12.08335F$

add all Σ

$\Sigma A_{total} = 475.2544SF\left(\frac{1\,SY}{9\,SF}\right)$

$= 52.806\,SY$

Total Area = 53 SY