Item 202 – Approach Slab Removed

Existing Approach slab width (ft); $W_{ex\_app} = 54$

Existing approach slab length (ft); $L_{ex\_app} = 20$

Total Area of 202 (SY); $\mathbf{T_{ex\_app} = ceiling(2} \times W_{ex\_app} \times L_{ex\_app} / 9, 1) = \mathbf{240.000}$

Item 202 – Wearing Course Removed

See calculation for Approach Slab Removed

Total Area of 202 (SY); **T_{ex_app} = 240.000**

<u>ITEM 202 – CONCRETE SLOPE PROTECTION REMOVED, AS PER PLAN</u>

*At undermined area at rear abutment (5'x5' panels, replace 3 across, 5 down)

Concrete panel area (sq ft); $A_{panel} = 25$

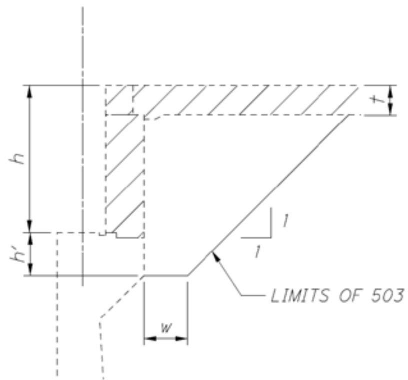
Panels to be replaced (each); $N_{repl} = 15$

TOTAL AREA OF SLOPE PROTECTION REMOVED (SQ YD); $\mathbf{T_{SP\_REM} = ceiling(A_{panel} \times N_{repl} / 9, 1) = 42.000}$

ITEM 503 – UNCLASSIFIED EXCAVATION, AS PER PLAN

*Unclassified excavation includes areas required to be excavated for the removal and replacement of backwalls and pier fiber wrap.

ABUTMENTS



Offset for new porous backfill (ft); $w_{PB} = 2$

Existing approach slab thickness (ft); $t_{ex\_app} = 1$

Average existing backwall height – RA (ft); $h_{avg\_RAex} = 7.22$

Average existing backwall height – FA (ft); $h_{avg\_FAex} = 7.08$

Additional excavation below backwall for new porous backfill (ft); $h' = 2$

Abutment length (inside of WW-to-WW) (ft); $L_{abut} = 62.167$

Area of 503 at rear abutment (sq ft); $A_{503\_RA} = (w_{PB} \times (h' + h_{avg\_RAex} - t_{ex\_app})) + 0.5 \times (h' + h_{avg\_RAex} - t_{ex\_app})^2 =$ **50.224**

Area of 503 at forward abutment (sq ft); $A_{503\_FA} = (w_{PB} \times (h' + h_{avg\_FAex} - t_{ex\_app})) + 0.5 \times (h' + h_{avg\_FAex} - t_{ex\_app})^2 =$ **48.803**

Volume at abutments (CF); $\mathbf{V_{abut\_503} = (A_{503\_RA} + A_{503\_FA}) \times L_{abut} = 6156.236}$

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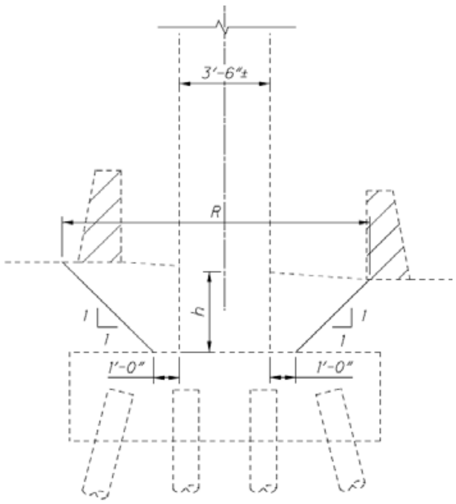
PIERS

Truncated cone volume = $\pi h / 3 (R^2 + Rr + r^2)$



Pier column diameter (ft); $d_{col} = 3.5$

Bottom cone radius (ft); $r_{cone} = (d_{col} + 2) / 2 = \mathbf{2.750}$

Pier 1:

Top cone radius (avg) (ft); $R_{P1} = 14 / 2 = \mathbf{7.000}$

Average height of fill over footing (ft); $h_{P1fill} = 4.25$

Pier 1 volume (CF); $V_{P1\_503} = 3 \times ((pi() \times h_{P1fill} / 3) \times (R_{P1}^2 + R_{P1} \times r_{cone} + r_{cone}^2) - pi() \times r_{cone}^2 \times h_{P1fill}) = \mathbf{709.313}$

Pier 2:

Top cone radius (avg) (ft); $R_{P2} = 11.33 / 2 = \mathbf{5.665}$

Average height of fill over footing (ft); $h_{P2fill} = 2.9167$

Pier 2 volume (CF); $V_{P2\_503} = 3 \times ((pi() \times h_{P2fill} / 3) \times (R_{P2}^2 + R_{P2} \times r_{cone} + r_{cone}^2) - pi() \times r_{cone}^2 \times h_{P2fill}) = \mathbf{298.221}$

Pier 3:

Top cone radius (avg) (ft); $R_{P3} = 13.12 / 2 = \mathbf{6.560}$

Average height of fill over footing (ft); $h_{P3fill} = 3.8333$

Pier 2 volume (CF); $V_{P3\_503} = 3 \times ((pi() \times h_{P3fill} / 3) \times (R_{P3}^2 + R_{P3} \times r_{cone} + r_{cone}^2) - pi() \times r_{cone}^2 \times h_{P3fill}) = \mathbf{553.344}$

Volume at piers (CF); $\mathbf{V_{piers\_503}} = V_{P1\_503} + V_{P2\_503} + V_{P3\_503} = \mathbf{1560.878}$

TOTAL VOLUME (CY); $\mathbf{T_{503} = ceiling((V_{abut\_503} + V_{piers\_503}) / 27,1) = 286.000}$

ITEM 509 – EPOXY COATED REINFORCING STEEL, AS PER PLAN

Substructures

Abutment and wingwall rebar (lb); $T_{509\_sub} = 13094$

Bridge Deck including sidewalk

Superstructure rebar (lb); $T_{509\_super} = 226303$

Parapet

Parapet rebar (lb); $T_{509\_par} = 22727$

Slope Protection Repairs

Slope protection rebar (lb); $T_{509\_slope} = 83$

TOTAL WEIGHT OF REINFORCING STEEL (LB); $\mathbf{T_{509} = ceiling(T_{509\_sub} + T_{509\_super} + T_{509\_par} + T_{509\_slope}, 1) = 262207.000}$

ITEM 509 – REINFORCING STEEL, REPLACEMENT OF EXISTING REINFORCING STEEL, AS PER PLAN

TOTAL WEIGHT OF REPLACEMENT STEEL (LB); T_{509_rep} **= 500**

ITEM 510 – DOWEL HOLES WITH NON-SHRINK, NON-METALLIC GROUT

Substructures

RA Backwall (A621 bars); $dow_{RA} = 136$

FA Backwall (A621 bars); $dow_{FA} = 136$

SE Wingwall (A503 & A622 bars); $dow_{se} = 42 + 12 =$ **54.000**

SW Wingwall (A622, A623, A624, A625); $dow_{sw} = 46 + 6 + 6 + 3 =$ **61.000**

NW Wingwall (A622, A623, A626, A627); $dow_{nw} = 40 + 6 + 6 + 3 =$ **55.000**

NE Wingwall (A503); $dow_{ne} = 10$

General

Concrete Slope Protection (CP501); $dow_{cp} = 40$

TOTAL DOWEL HOLES FOR REBAR (EA); $T_{510\_sub} = \text{ceiling}((dow_{RA} + dow_{FA} + dow_{se} + dow_{sw} + dow_{nw} + dow_{ne} + dow_{cp}), 1) = 492.000$

ITEM 511 – CLASS QC2 CONCRETE WITH QC/QA, BRIDGE DECK, AS PER PLAN

Primary Deck

Proposed deck width (ft); $W_{deck} = 66$

Proposed bridge limits (ft); $L_{deck} = 414.4167$

Proposed deck thickness (in); $t_{deck} = 8.75$

Volume of primary deck (cu ft); $V_{deck} = (W_{deck} \times L_{deck} \times t_{deck} / 12) = \mathbf{19943.804}$

Sidewalk

Sidewalk width (ft); $W_{walk} = 6$

Parapet width (ft); $W_{par} = 1.167$

Sidewalk overhang (ft); $over = 2/12 = \mathbf{0.167}$

Curb height (ft); $curb = 8/12$

Sidewalk cross-slope (ft/ft); $cross_{walk} = 0.02$

Average walk thickness (ft); $t_{walk\_avg} = curb + cross_{walk} \times W_{walk} / 2 = \mathbf{0.727}$

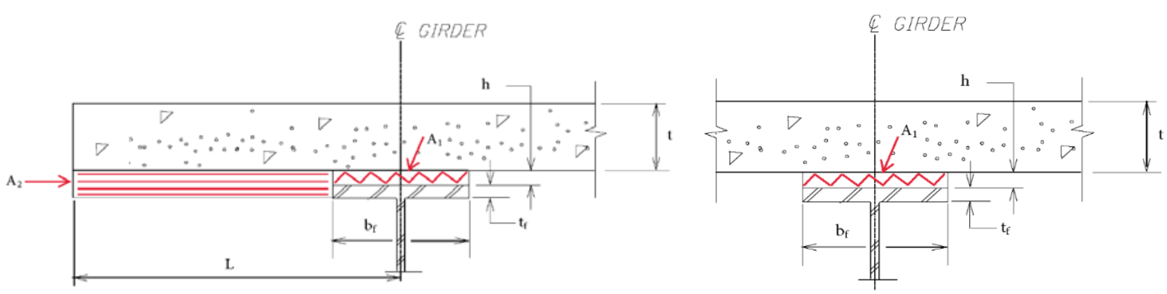
Walk thickness under parapet (ft); $t_{walk\_par} = curb + cross_{walk} \times W_{walk} = \mathbf{0.787}$

Walk c-s area (sq ft); $A_{walk} = t_{walk\_avg} \times W_{walk} + t_{walk\_par} \times (W_{par} + over) = \mathbf{5.409}$

Volume of sidewalk (cu ft); $V_{walk} = 2 \times L_{deck} \times A_{walk} = \mathbf{4483.285}$

Haunches

Average haunch (all beams) (in); $h_{avg} = 3.08$



Top flange width (ft); $b_f = 16/12 = \mathbf{1.333}$

Average flange thickness (weighted over length) (in); $t_f = ((1.5 \times 152) + (2.25 \times 124) + (1.25 \times 139)) / (152+124+139) = \mathbf{1.640}$

Fascia overhang (ft); $L_{fascia} = 4$

Number of interior beams (each); $N_{int} = 5$

Number of fascia beams (each); $N_{ext} = 2$

Haunch volume – interior beams (cu ft); $V_{haunch\_int} = b_f \times (h_{avg}/12) \times L_{deck} \times N_{int} = \mathbf{709.113}$

Haunch volume – fascia beams (cu ft); $V_{haunch\_ext} = (b_f \times (h_{avg}/12) + (L_{fascia} - (b_f / 2)) \times ((h_{avg} + t_f)/12)) \times L_{deck} \times N_{ext} =$ **1370.421**

TOTAL VOLUME OF CONCRETE (CU YD); $\mathbf{T_{deck}} = \mathbf{ceiling((}V_{deck} + V_{walk} + V_{haunch\_int} + V_{haunch\_ext}\mathbf{)/ 27, 5) = 985.000}$

ITEM 511 – CLASS QC2 CONCRETE WITH QC/QA, BRIDGE DECK (PARAPET), AS PER PLAN

Proposed bridge limits (ft); L_{deck} = **414.417**

SW Wingwall length (ft); L_{sw} = 44-2.25 = **41.750**

SE Wingwall length (ft); L_{se} = 34.5 – 2.25 = **32.250**

NW Wingwall length (ft); L_{nw} = 39.5-2.25 = **37.250**

NE Wingwall length (ft); L_{ne} = 25.5-2.25 = **23.250**

1) Primary Parapet Concrete

Total Parapet width (ft); w_{par} = **1.167**

Parapet formliner thickness (each face) (ft); $t_{formliner}$ = 1/12 = **0.083**

Parapet height (ft); h_{par} = 2 +8/12 = **2.667**

Parapet area (sq ft); $A_{par} = (w_{par} - 2 \times t_{formliner}) \times h_{par}$ = **2.668**

Parapet volume (cu ft); $V_{par} = A_{par} \times (2 \times L_{deck} + L_{sw} + L_{se} + L_{nw} + L_{ne})$ = **2569.745**

2) Light Pole Pilaster Concrete

Light pole pilaster stem width (ft); w_{pil} = 2.6667

Light pole pilaster stem thickness (ft); t_{pil} = 1.8333

Pilaster stem height (ft); h_{pil} = 3 + 11.5/12 = **3.958**

Number of light poles (each); N_{poles} = 10

Light pole pilaster cap height (ft); h_{pil_cap} = 0.5

Pilaster cap overhang (ft); ov_{pil_cap} = 2/12 = **0.167**

Average slab thickness at overhangs (ft); $t_{ovhg} = (t_{deck} + h_{avg} + t_f) / 12$ = **1.123**

Pilaster volume (cu ft); $V_{pil} = N_{poles} \times (w_{pil} \times t_{pil} \times h_{pil} + h_{pil\_cap} \times ((w_{pil} + 2 \times ov_{pil\_cap}) \times (t_{pil} + ov_{pil\_cap})) + t_{ovhg} \times (t_{pil} + ov_{pil\_cap}))$ = **245.967**

3) Additional concrete required for parapet formliner & lettering (both faces)

Parapet formliner thickness (ft); $t_{formliner}$ = **0.083**

Parapet formliner band width (ft); w_{form_band} = 0.5

Vertical formliner band height (ft); $h_{form\_band} = h_{par} - 2 \times w_{form\_band}$ = **1.667**

Number of vertical formliner bands (outside face) (see elev view); $N_{form\_band\_out}$ = 3+17+22+7+1+1+6+17+3 = **77.000**

Number of vertical formliner bands (inside face) (see elev view); $N_{form\_band\_in}$ = 2+17+22+7+8+6+17+2 = **81.000**

Number of vertical formliner bands (both faces) (all wingwalls); $N_{form\_band\_ww} = 2 \times (7 + 6 + 7 + 9)$ = **58.000**

Total number of vertical formliner bands; $N_{form\_band} = 2 \times (N_{form\_band\_out} + N_{form\_band\_in}) + N_{form\_band\_ww}$ = **374.000**

Primary formliner volume (cu ft); $V_{form1} = (h_{form\_band} \times w_{form\_band} \times t_{formliner} \times N_{form\_band}) + (4 \times (2 \times L_{deck} + L_{sw} + L_{se} + L_{nw} + L_{ne}) \times t_{formliner} \times w_{form\_band})$ = **186.528**

Additional width at light pilasters (outside); w_{form_LP} = 2.167 – 0.5 = **1.667**

Number of light poles (each); N_{poles} = **10.000**

Additional formliner volume (cu ft); $\mathbf{V_{form2} = 2 \times N_{poles} \times h_{form\_band} \times W_{form\_LP} \times t_{formliner} = 4.631}$

Additional thickness at parapet lettering (outside); $t_{letters} = 2/12 = \mathbf{0.167}$

Parapet height at lettered section (ft); $h_{letters} = 3.45833$

Length of lettered section (ft); $L_{letters} = 45$

Additional lettering volume (cu ft); $\mathbf{V_{form3} = 2 \times L_{letters} \times t_{letters} \times h_{letters} = 51.875}$

Total Aesthetic concrete (CU YD); $\mathbf{V_{par\_form}} = V_{form1} + V_{form2} + V_{form3} = \mathbf{243.033}$

TOTAL VOLUME OF CONCRETE (CU YD); $\mathbf{T_{par} = ceiling((}V_{par} + V_{pil} + V_{par\_form}\mathbf{) / 27, 5) = 115.000}$

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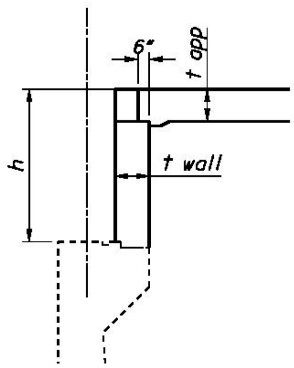
ITEM 511 – CLASS QC1 CONCRETE, ABUTMENT NOT INCLUDING FOOTING



Proposed approach slab thickness (ft); t_{app} = 17/12 = **1.417**

Abutment length (inside face WW to WW) (ft); L_{abut} = **62.167**

Wingwall thickness at abutment (NW & SW only) (ft); t_{ww_abut} = 2

Wingwall thickness primary (ft); t_{ww} = 1.5

Abutment length (o/o of wingwalls) (ft); $L_{abut\_oo} = L_{abut} + t_{ww\_abut} + t_{ww}$ = **65.667**

Sidewalk c-s area (sq ft); A_{walk} = **5.409**

Rear Abutment

RA backwall thickness (ft); t_{back_RA} = 1.75

Average backwall height (elev area from CAD / abut length) (ft); $h_{RA} = 472.7 / L_{abut\_oo}$ = **7.198**

Volume RA (cu ft); $V_{back\_RA} = L_{abut\_oo} \times (t_{back\_RA} \times (h_{RA} - t_{app}) + (t_{back\_RA} - 0.5) \times t_{app}) + 2 \times A_{walk} \times (t_{back\_RA} - 0.5)$ = **794.234**

Forward Abutment

FA backwall thickness (ft); t_{back_FA} = 1.75

Average backwall height (elev area from CAD / abut length) (ft); $h_{FA} = 460.0 / L_{abut\_oo}$ = **7.005**

Volume FA (cu ft); $V_{back\_FA} = L_{abut\_oo} \times (t_{back\_FA} \times (h_{FA} - t_{app}) + (t_{back\_FA} - 0.5) \times t_{app}) + 2 \times A_{walk} \times (t_{back\_FA} - 0.5)$ = **772.009**

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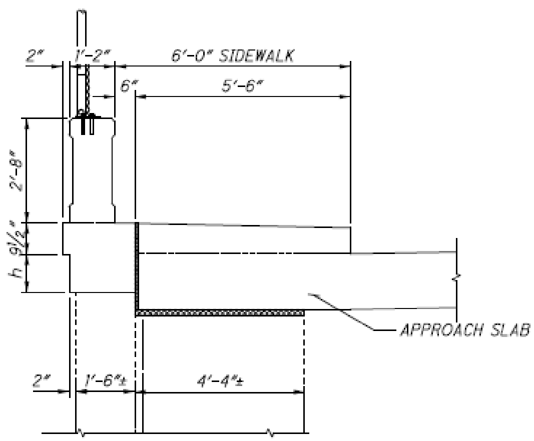
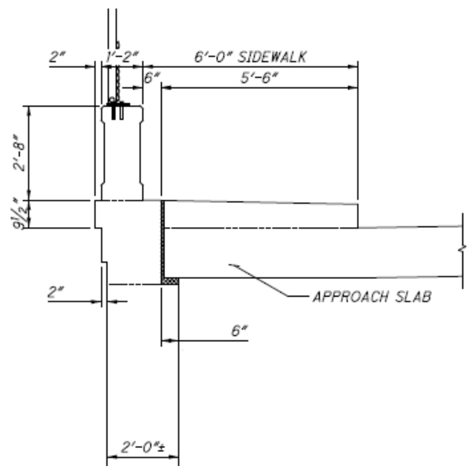
__Wingwalls__

Typical WW section:



WW Section at full backwall height replacement (SW & NW only):



SE Wingwall:

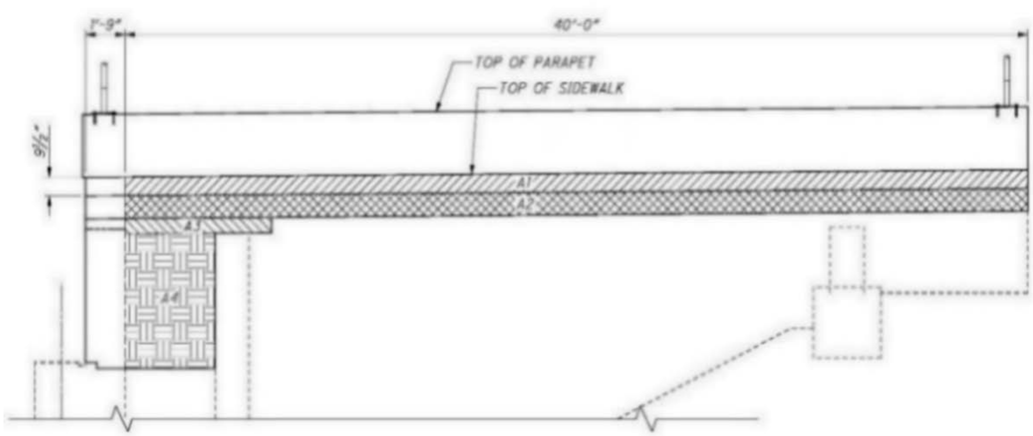
SE Wingwall length (ft); L_{se} = **32.250**

Replacement thickness (ft); $h_{se} = 11.5 / 12 =$ **0.958**

Replacement area (sq ft); $A_{se} = (h_{se} \times t_{ww}) + (9.5 \times (t_{ww} + 2/12) / 12) =$ **2.757**

Vol for SE wingwall (cu ft); $V_{se} = A_{se} \times (L_{se} - t_{back\_RA}) =$ **84.087**

SW Wingwall:



SW Wingwall length (ft); L_{sw} = **41.750**

Area 1 (sq ft); $A1_{sw} = 31.5$

Area 2 (sq ft); $A2_{sw} = 38.7$

Area 3 (sq ft); $A3_{sw} = 4.2$

Area 4 (sq ft); $A4_{sw} = 22.8$

Vol for SW wingwall (cu ft); $V_{sw} = (A1_{sw} \times 1.833) + (A2_{sw} \times 1.667) + (A3_{sw} \times 1.5) + (A4_{sw} \times 2) =$ **174.152**

NE Wingwall: No new concrete – approach slab extends over existing portion of wingwall to remain.

Vol for NW wingwall (cu ft); $V_{ne} = 0$

NW Wingwall: See diagram for SW Wingwall, replacement areas are similar

NW Wingwall length (ft); $L_{nw} = \mathbf{37.250}$

Area 1 (sq ft); $A1_{nw} = 27.9$

Area 2 (sq ft); $A2_{nw} = 35.8$

Area 3 (sq ft); $A3_{nw} = 3.9$

Area 4 (sq ft); $A4_{nw} = 21.2$

Vol for NW wingwall (cu ft); $V_{sw} = (A1_{nw} \times 1.833) + (A2_{nw} \times 1.667) + (A3_{nw} \times 1.5) + (A4_{nw} \times 2) = \mathbf{159.069}$

Total Vol of concrete for substructures (CY); $\mathbf{T_{511sub}} = \mathbf{ceiling((}V_{back\_RA} + V_{back\_FA} + V_{sw} + V_{se} + V_{nw} + V_{ne})/ 27, 5) = \mathbf{75.000}$

ITEM 512 – SEALING CONCRETE SURFACES (EPOXY-URETHANE)

Abutments

*Top of backwall to ground line

Rear abutment elevation area (CAD) (sq ft); $A_{512\_RA} = 1124.4$

Forward abutment elevation area (CAD) (sq ft); $A_{512\_FA} = 971.5$

Abutment length (ft); $L_{abut\_oo} = \mathbf{65.667}$

RA beam seat depth (ft); $d_{RA} = 2.25$

FA beam seat depth (ft); $d_{FA} = 2.25$

Total abutment area (sq ft); $A_{512\_abut} = A_{512\_RA} + A_{512\_FA} + (d_{RA} + d_{FA}) \times L_{abut\_oo} = \mathbf{2391.402}$

Wingwalls

*Top of wingwall to ground line

SW Wingwall elevation area (sq ft); $A_{512\_SW} = 435.7$

SE Wingwall elevation area (sq ft); $A_{512\_SE} = 217.4$

NW Wingwall elevation area (sq ft); $A_{512\_NW} = 382.4$

NE Wingwall elevation area (sq ft); $A_{512\_NE} = 123.2$

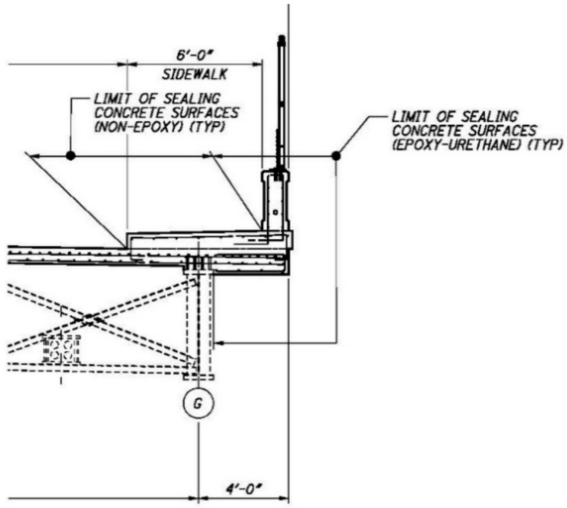
Wingwall end area (sq ft); $A_{ww\_end} = t_{ww} \times 11/12 = \mathbf{1.375}$

Total wingwall area (sq ft); $A_{512\_ww} = A_{512\_SW} + A_{512\_SE} + A_{512\_NW} + A_{512\_NE} + (4 \times A_{ww\_end}) = \mathbf{1164.200}$

Piers

*Piers to be fiber-wrapped and sealed with urethane only sealer.

Deck and Parapet (on bridge deck)



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Proposed bridge limits (ft); L_{deck} = **414.417**
Sidewalk width (ft); w_{walk} = **6.000**
Parapet width (ft); w_{par} = **1.167**
Parapet height (ft); h_{par} = **2.667**
Sidewalk overhang (ft); over = **0.167**
Curb height (ft); curb = **0.667**
Sidewalk thickness under parapet (ft); t_{walk_par} = **0.787**
Average haunch (all beams) (in); h_{avg} = **3.080**
Average flange thickness (weighted over length) (in); t_f = **1.640**
Proposed deck thickness (in); t_{deck} = **8.750**
Fascia overhang (ft); L_{fascia} = **4.000**
Girder flange width (ft); b_f = **1.333**

Sealing perimeter (ft); $P_{deck} = (2 \times h_{par}) + w_{par} + (2 \times over) + t_{walk\_par} + (h_{avg} + t_f + t_{deck})/12 + (L_{fascia} – b_f / 2)$ = **12.076**

Total sealing area on bridge deck (sq ft); $A_{512\_deck} = P_{deck} \times L_{deck} \times 2$ = **10009.155**

Parapets (on wingwalls)
*Top of wingwall to toe of parapet at sidewalk

SW Wingwall length (ft); L_{sw} = **41.750**
SE Wingwall length (ft); L_{se} = **32.250**
NW Wingwall length (ft); L_{nw} = **37.250**
NE Wingwall parapet length (ft); L_{ne_par} = 23.5

Perimeter of parapet (ft); $P_{par} = (2 \times h_{par}) + w_{par}$ = **6.500**
End area of parapet (sq ft); A_{par} = **2.668**

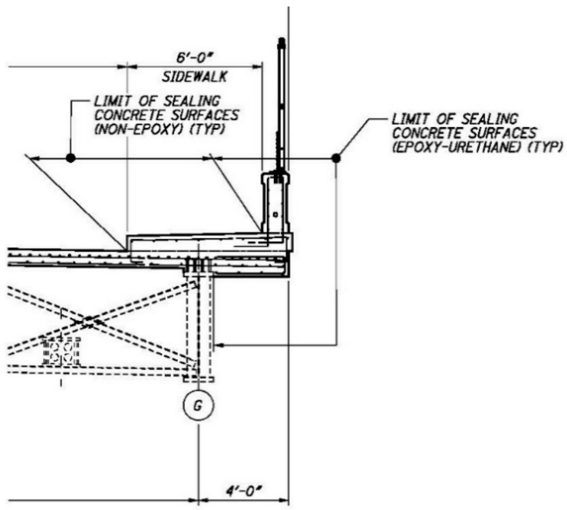
Total sealing area of parapets on wingwalls (sq ft); $A_{512\_par} = (4 \times A_{par}) + P_{par} \times (L_{sw} + L_{se} + L_{nw} + L_{ne\_par})$ = **886.590**

TOTAL AREA OF SEALING (SY); T_{512} = ceiling(($A_{512\_abut} + A_{512\_ww} + A_{512\_deck} + A_{512\_par}$) / 9, 1) = 1606.000

<u>ITEM 512 – SEALING CONCRETE SURFACES (NON-EPOXY)</u>

*All sidewalks and faces of curbs

<u>Sidewalk on bridge deck</u>



Proposed bridge limits (ft); L_{deck} = **414.417**

Sidewalk width (ft); w_{walk} = **6.000**

Curb height (ft); curb = **0.667**

Sealing perimeter (ft); $P_{walk} = w_{walk} + curb$ = **6.667**

Total sealing area on bridge deck (sq ft); $A_{512\_decksw} = P_{walk} \times L_{deck} \times 2$ = **5525.556**

<u>Approach sidewalks (on wingwalls and approach slabs</u>

Length of approach slabs (Ft); $L_{app} = 30$

Width of Type C installation header (ft); $w_{type\_c} = 2$

NE Wingwall sidewalk plan area (CAD) (sq ft); $A_{ne\_walk} = 249.5$

Total sealing area on approaches (sq ft); $A_{512\_appsw} = (A_{ne\_walk} + curb \times (L_{app} + w_{type\_c})) + 3 \times P_{walk} \times (L_{app} + w_{type\_c})$ = **910.833**

TOTAL AREA OF SEALING (SY); $T_{512\_non} = \mathrm{ceiling}((A_{512\_decksw} + A_{512\_appsw}) / 9, 1)$ = 716.000

ITEM 512 – TYPE 2 WATERPROOFING

*3'-0" wide at backwall-to-seat joint and 3'-0' wide vertically at NE & SE wingwall contraction joint

Width of waterproofing (ft); $W_{Type2} = 3$

Abutment length (ft); $L_{abut} = \mathbf{62.167}$

Backwall height wingwall replacement section (ft); $L_{ww} = 4$

SE Wingwall replacement height (ft); $H_{se} = 8.13$

NE Wingwall replacement height (ft); $H_{ne} = 7.58$

Total Area of Type 2 Waterproofing (SY); $\mathbf{A_{Type2} = ceiling(W_{Type2} \times (2 \times (L_{abut} + L_{ww}) + H_{se} + H_{ne}) / 9, 1) = 50.000}$

ITEM 512 – CONCRETE REPAIR BY EPOXY INJECTION

*From Repair Plan

Total Length of Epoxy Injection (Ft); $\mathbf{T_{epox} = 252}$

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ITEM 512 – URETHANE TOP COAT SEALER

*Sealer applied over FRP wrap at piers. Fiber wrap around columns from top of footing to bottom of cap and around cap sides and bottom face with assumed 6" return on top face at both sides.

Pier cap length (ft); $L_{cap} = 62$

Pier cap width (ft); $w_{cap} = 3.5$

Pier cap end height (ft); $h_{cap\_end} = 3.75$

Pier column diameter (ft); $d_{col} = 3.5$

Top of pier cap area sealed (sq ft); $A_{cap\_top} = L_{cap} \times (0.5 + 0.5) = \mathbf{62.000}$

Bottom of cap area (CAD) (sq ft); $A_{cap\_bott} = (L_{cap} \times w_{cap}) - 3 \times pi() \times d_{col}^2 / 4 = \mathbf{188.137}$

End of cap area (sq ft); $A_{cap\_end} = w_{cap} \times h_{cap\_end} = \mathbf{13.125}$

Pier 1:

Cap elevation area (CAD) (sq ft); $A_{P1\_el} = 298.13$

Total cap area (sq ft); $A_{P1\_cap} = (2 \times A_{P1\_el} + 2 \times A_{cap\_end} + A_{cap\_top} + A_{cap\_bott}) = \mathbf{872.647}$

Average column height (to top of footing) (ft); $H_{P1\_col} = 27.75$

Total column area (sq ft); $A_{P1\_col} = 3 \times pi() \times d_{col} \times H_{P1\_col} = \mathbf{915.382}$

Total area Pier 1 (sq ft); $A_{P1} = A_{P1\_cap} + A_{P1\_col} = \mathbf{1788.028}$

Pier 2:

Cap elevation area (CAD) (sq ft); $A_{P2\_el} = 300.12$

Total cap area (sq ft); $A_{P2\_cap} = (2 \times A_{P2\_el} + 2 \times A_{cap\_end} + A_{cap\_top} + A_{cap\_bott}) = \mathbf{876.627}$

Average column height (to top of footing) (ft); $H_{P2\_col} = 27.25$

Total column area (sq ft); $A_{P2\_col} = 3 \times pi() \times d_{col} \times H_{P2\_col} = \mathbf{898.888}$

Total area Pier 2 (sq ft); $A_{P2} = A_{P2\_cap} + A_{P2\_col} = \mathbf{1775.515}$

Pier 3:

Cap elevation area (CAD) (sq ft); $A_{P3\_el} = 297.31$

Total cap area (sq ft); $A_{P3\_cap} = (2 \times A_{P3\_el} + 2 \times A_{cap\_end} + A_{cap\_top} + A_{cap\_bott}) = \mathbf{871.007}$

Average column height (to top of footing) (ft); $H_{P3\_col} = 22.583$

Total column area (sq ft); $A_{P3\_col} = 3 \times pi() \times d_{col} \times H_{P3\_col} = \mathbf{744.939}$

Total area Pier 3 (sq ft); $A_{P3} = A_{P3\_cap} + A_{P3\_col} = \mathbf{1615.946}$

Total Area of Urethane Top Coat (SY); $\mathbf{A_{urethane} = ceiling((A_{P1} + A_{P2} + A_{P3}) / 9, 1) = 576.000}$

ITEM 512 – REMOVAL OF EXISTING COATINGS FROM CONCRETE SURFACES

*Removal at the following locations:

- Abutment breastwalls from top of slope protection to and including beam seat.
- Wingwalls from existing ground line up to removal line
- None at piers as existing coating removals is included with surface prep for fiber wrap system.

Abutments

Rear abutment elevation area (CAD) (sq ft); $A_{rem\_RA} = 662.5$

Forward abutment elevation area (CAD) (sq ft); $A_{rem\_FA} = 519.9$

Abutment length (ft); $L_{abut\_oo} = \mathbf{65.667}$

RA beam seat depth (ft); $d_{RA} = \mathbf{2.250}$

FA beam seat depth (ft); $d_{FA} = \mathbf{2.250}$

Total abutment area (sq ft); $A_{rem\_abut} = A_{rem\_RA} + A_{rem\_FA} + (d_{RA} + d_{FA}) \times L_{abut\_oo} = \mathbf{1477.902}$

Wingwalls

SW Wingwall elevation area (sq ft); $A_{rem\_SW} = 324.5$

SE Wingwall elevation area (sq ft); $A_{rem\_SE} = 152.2$

NW Wingwall elevation area (sq ft); $A_{rem\_NW} = 278.5$

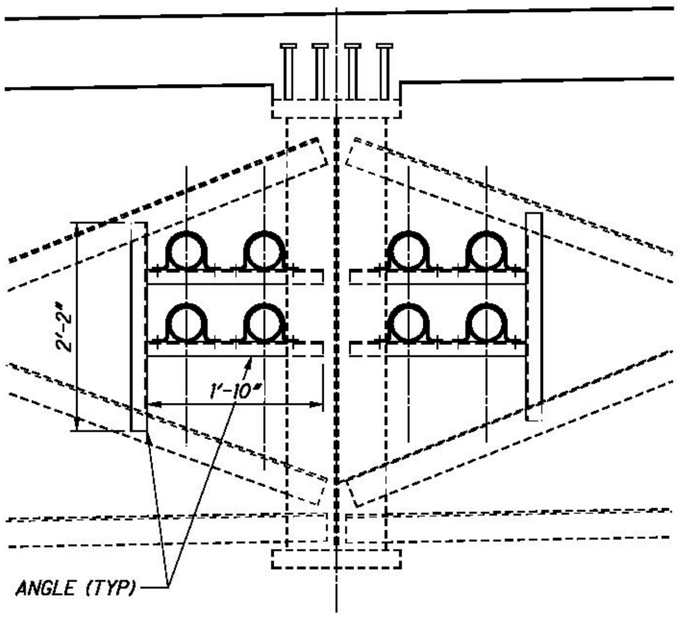
NE Wingwall elevation area (sq ft); $A_{rem\_NE} = 62.7$

Total wingwall area (sq ft); $A_{rem\_ww} = A_{rem\_SW} + A_{rem\_SE} + A_{rem\_NW} + A_{rem\_NE} = \mathbf{817.900}$

Total Area of Coating Removed (SY); $\mathbf{A_{coating\_removed} = ceiling((A_{rem\_abut} + A_{rem\_ww}) / 9, 1) = 256.000}$

ITEM 513 – STRUCTURAL STEEL MEMBERS, LEVEL UF, AS PER PLAN

*Item includes steel for new utility conduit supports to be paid for by utility owners.



L2x2x3/8" unit weight per ft (lb/ft); wt_{ang} = 4.7

Total Length of steel per support location (ft); $L_{ang} = 2 \times 2.167 + 4 \times 1.833 =$ **11.666**

Total number of support locations; N_{util} = 29

TOTAL WEIGHT OF STEEL (LB); $\mathbf{T_{513\_util} = ceiling(L_{ang} \times wt_{ang} \times N_{util}, 10) = 1600.000}$

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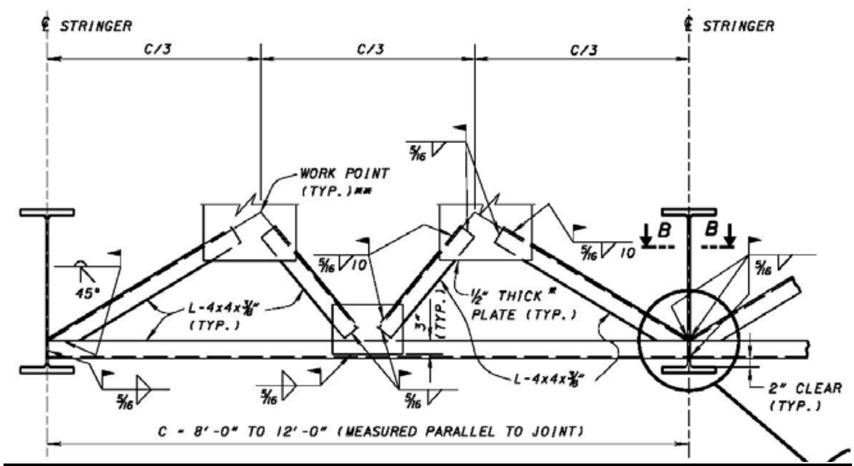
ITEM 513 – REPLACEMENT OF DETERIORATED END CROSSFRAMES

Typical End Crossframe:



Total number of typical end cross-frames (each); $T_{CF} = 8$

Girder web height (ft); $h_{web} = 54/12 = \mathbf{4.500}$

Beam spacing (ft); $C_{spa} = 9+8/12 = \mathbf{9.667}$

L4x4x3/8" unit weight per ft (lb/ft); $wt_L = 9.8$

Plate thickness (in); $t_{cf\_pl} = 0.5$

Top plate area (sq ft); $A_{cf\_pl1} = 2.61$

Bottom plate area (sq ft); $A_{cf\_pl2} = 1.78$

Unit weight of steel (pcf); $wt_{stl} = 490$

Bottom member length (ft); $L_{bott} = C_{spa} = \mathbf{9.667}$

Outside diagonal length (ft); $L_{diag1} = \text{sqrt}((C_{spa} / 3)^2 + (h_{web} - 6/12)^2) = \mathbf{5.136}$

Inside diagonal length (ft); $L_{diag2} = \text{sqrt}((C_{spa} / 6)^2 + (h_{web} - 6/12)^2) = \mathbf{4.312}$

Total weight of typical crossframe (lb); $wt_{CF} = wt_L \times (L_{bott} + 2 \times (L_{diag1} + L_{diag2})) + wt_{stl} \times t_{cf\_pl} \times (2 \times A_{cf\_pl1} + A_{cf\_pl2})/12$

$= \mathbf{422.844}$

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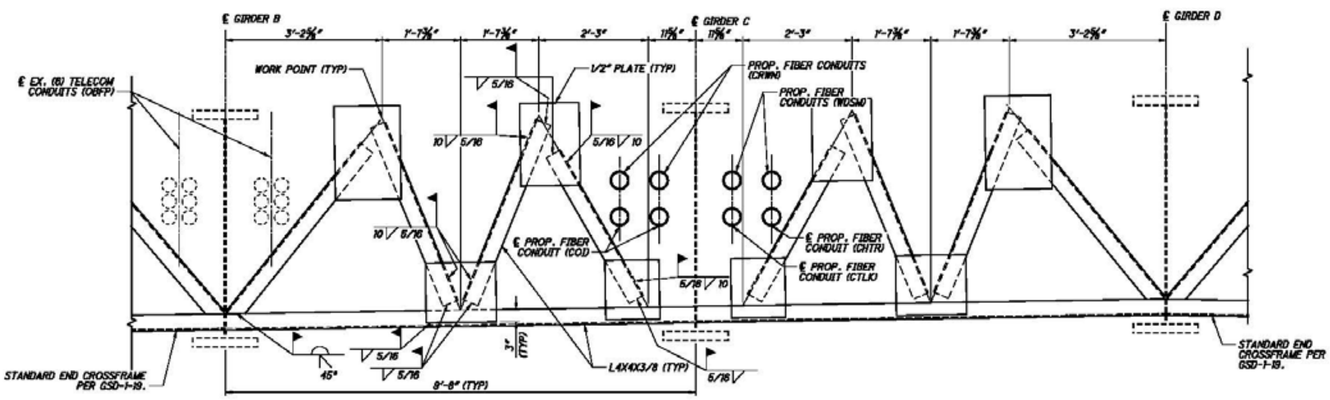
Special End Crossframe (at Girder B-C Bay & Girder C-D Bay, both ends to allow for proposed fiber conduits):



SPECIAL END CROSSFRAMES
(TYPICAL 4 LOCATIONS)

Total number of special end cross-frames (each); $T_{CFS} = 4$

Top plate area (sq ft); $A_{cf\_pl3} = 2.08$

Bottom plate area (sq ft); $A_{cf\_pl4} = 1.36$

Bottom member length (ft); $L_{bott} = C_{spa} = \mathbf{9.667}$

Left diagonal length (ft); $L_{diag3} = L_{diag1} = \mathbf{5.136}$

Inside diagonal length (ft); $L_{diag4} = L_{diag2} = \mathbf{4.312}$

Right diagonal length (ft); $L_{diag5} = \mathrm{sqrt}((2.25)^2 + (h_{web} - 6/12)^2) = \mathbf{4.589}$

Total weight of typical crossframe (lb); $wt_{CFS} = wt_L \times (L_{bott} + L_{diag3} + (2 \times L_{diag4}) + L_{diag5}) + wt_{stl} \times t_{cf\_pl} \times (A_{cf\_pl1} + A_{cf\_pl2} + A_{cf\_pl3} + A_{cf\_pl4})/12 = \mathbf{434.429}$

TOTAL WEIGHT OF STEEL (LB); $\mathbf{T_{513} = ceiling(T_{CF} \times wt_{CF} + T_{CFS} \times wt_{CFS}, 5) = 5125.000}$

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ITEM 513 – WELDED SHEAR STUD CONNECTORS

Studs per location; stud = 4

Locations per beam line; loc = 210

Number of interior beams (each); N_{int} = **5.000**

Number of fascia beams (each); N_{ext} = **2.000**

TOTAL NUMBER OF SHEAR STUDS (EA); $\mathbf{T_{stud} = (stud \times loc \times (N_{int} + N_{ext})) = 5880.000}$

ITEM 513 – TRIMMING OF BEAM ENDS, AS PER PLAN

TOTAL NUMBER OF BEAM ENDS TRIMMED (EA); $T_{trim} = 9$

ITEM 514 – SURFACE PREPARATION OF EXISTING STRUCTURAL STEEL

ITEM 514 – FIELD PAINTING OF EXISTING STRUCTURAL STEEL, PRIME COAT

ITEM 514 – FIELD PAINTING STRUCTURAL STEEL, INTERMEDIATE COAT

ITEM 514 – FIELD PAINTING STRUCTURAL STEEL, FINISH COAT, AS PER PLAN

Girder web height (ft); h_{web} = **4.500**

Flange width (ft); b_f = **1.333**

Web thickness (ft); t_{web} = 0.375/12 = **0.031**

Number of interior beams (each); N_{int} = **5.000**

Number of fascia beams (each); N_{ext} = **2.000**

Girder Section 1

Length of Section 1 per beam line (ft); L_{G1} = 75 + 75 + 1 + 1 = **152.000**

Flange thickness (ft); t_{f1} = 1.5/12 = **0.125**

Girder perimeter (ft); $P_{G1} = b_f + 2 \times (h_{web} + 2 \times t_{f1} + (b_f - t_{web}))$ = **13.438**

Girder Section 2

Length of Section 2 per beam line (ft); L_{G2} = 42 + 3.46/2 + 40 + 3.46/2 + 42 + 3.46/2 = **129.190**

Flange thickness (ft); t_{f2} = 2.25/12 = **0.188**

Girder perimeter (ft); $P_{G2} = b_f + 2 \times (h_{web} + 2 \times t_{f2} + (b_f - t_{web}))$ = **13.688**

Girder Section 3

Length of Section 3 per beam line (ft); L_{G3} = 71.5 -3.46/2 + 67.5 – 3.46 = **133.810**

Flange thickness (ft); t_{f3} = 1.25/12 = **0.104**

Girder perimeter (ft); $P_{G3} = b_f + 2 \times (h_{web} + 2 \times t_{f3} + (b_f - t_{web}))$ = **13.354**

Stiffeners

Stiffener thickness (ft); t_{stiff} = 1.25/12 = **0.104**

Stiffener width (ft); w_{stiff} = 7/12 = **0.583**

Stiffener area (sq ft); $A_{stiff} = (t_{stiff} \times h_{web}) + (2 \times h_{web} \times w_{stiff})$ = **5.719**

Total stiffeners per beam line (inclu CF plates) (each); N_{stiff} = 254

TOTAL AREA OF PAINTING (SQ FT); $T_{514} = \text{ceiling}((N_{int} + N_{ext}) \times ((P_{G1} \times L_{G1} + P_{G2} \times L_{G2} + P_{G3} \times L_{G3}) + (A_{stiff} \times N_{stiff})) \times 1.20, 1)$ = **59223.000**

*Includes 20% additional for cross-frames and incidentals

ITEM 514 – GRINDING FINS, TEARS, SLIVERS ON EXISTING STRUCTURAL STEEL

*Per BDM, one (1) minute per linear foot of beam

Length of beams (ft); $L_{beam} = 415$

Number of interior beams (each); $N_{int} = \mathbf{5.000}$

Number of fascia beams (each); $N_{ext} = \mathbf{2.000}$

TOTAL TIME GRINDING (HRS); $\mathbf{T_{grind} = ceiling((N_{int} + N_{ext}) \times L_{beam} / 60, 1) = 49.000}$

<u>ITEM 514 – FINAL INSPECTION REPAIR</u>

*Per CMS, one location per 150 linear foot of girder & 5% of all crossframes

Length of beams (ft); L_{beam} = **415.000**

Number of interior beams (each); N_{int} = **5.000**

Number of fascia beams (each); N_{ext} = **2.000**

Number of crossframes per beam; N_{cf} = 31

Total number of crossframes; $N_{cf\_tot} = N_{cf} \times (N_{int} + N_{ext} - 1)$ = **186.000**

Number of locations per beam line (each); N_{inspec_bm} = ceiling(L_{beam} / 150, 1) = **3.000**

Number of locations on crossframes (each); N_{inspec_cf} = ceiling(0.05 $\times$ N_{cf_tot}, 1) = **10.000**

TOTAL NUMBER OF INSPECTION LOCATIONS (EA); $T_{inspec} = ((N_{int} + N_{ext}) \times N_{inspec\_bm}) + N_{inspec\_cf}$ = 31.000

ITEM 516 – STRUCTURAL EXPANSION JOINT INCLUDING ELASTOMERIC STRIP SEAL

Proposed deck width (ft); w_{deck} = **66.000**

TOTAL LENGTH OF JOINT (FT); $\mathbf{L_{EXP} = ceiling(2 \times w_{deck}, 1) = 132.000}$

ITEM 516 – ARMORLESS PREFORMED JOINT SEAL

*At Approach Slab Installation Type C

Rear approach slab width(ft); $w_{rear\_app} = 62.5$

Fwd approach slab width at end (ft); $w_{fwd\_app} = 63.083$

TOTAL LENGTH OF JOINT (FT); $\mathbf{L_{PJS} = ceiling(w_{rear\_app} + w_{fwd\_app}, 1) = 126.000}$

ITEM 516 – 1/2” PREFORMED EXPANSION JOINT FILLER

*At wingwall contraction joint at NW and SW corners

SW hieght of joint (ft); $h_{cont\_sw} = 8.12$

NW height of joint (ft); $h_{cont\_nw} = 7.63$

Width of joint (ft); $w_{cont} = 2$

Height of parapet (ft); $h_{par} = \mathbf{2.667}$

Width of parapet (Ft); $w_{par} = \mathbf{1.167}$

TOTAL AREA OF PEJF (SQ FT); $\mathbf{A_{pejf\_12} = ceiling((h_{cont\_sw} + h_{cont\_nw}) \times w_{cont} + 2 \times h_{par} \times w_{par}, 1) = 38.000}$

ITEM 516 – 1" PREFORMED EXPANSION JOINT FILLER

*Between inside face of wingwalls and integral approach slab sidewalk.

Length of approach slabs (Ft); L_{app} = **30.000**

Width of Type C installation header (ft); w_{type_c} = **2.000**

Typical approach slab thickness (ft); t_{app} = **1.417**

Width of sidewalk on approach slab (ft); $w_{app\_walk} = 5.5$

Curb height (ft); curb = **0.667**

Approach slab thickness at joint (ft); $t_{app\_pejf} = t_{app} + curb + 0.02 \times w_{app\_walk}$ = **2.193**

TOTAL AREA OF PEJF (SQ FT); $\mathbf{A_{pejf1} = ceiling(3 \times (L_{app} + w_{type\_c}) \times t_{app\_pejf}, 1) = 211.000}$

ITEM 516 – 2” PREFORMED EXPANSION JOINT FILLER

*Under approach slab, above wingwall at SW & NW corners and full length of NE wingwall

Plan area of overlap at SW & NW corners (CAD) (sq ft); $A_{corn} = 0.5 \times 5.5 + 0.5 \times 0.5 \times 1 =$ **3.000**

NE WW length (ft); L_{ne} = **23.250**

Backwall thickness (ft); t_{back_RA} = **1.750**

NE WW length (beyond backwall) (ft); $L_{ne\_pejf} = L_{ne} - t_{back\_RA}$ = **21.500**

NE WW thickness (ft); t_{ww} = **1.500**

TOTAL AREA OF PEJF (SQ FT); $\mathbf{A_{pejf2} = ceiling(2 \times A_{corn} + L_{ne\_pejf} \times t_{ww}, 1) = 39.000}$

ITEM 516 – RESET BEARINGS

*At rocked bearings at rear abutment Beams A – E, and abutment bearings with beam seat deterioration (RA Beam F, FA Beams B – D)

TOTAL NUMBER OF BEARINGS RESET (EA); $\mathbf{T_{reset} = 9}$

ITEM 516 – ELASTOMERIC BEARING WITH INTERNAL LAMINATES AND LOAD PLATE (NEOPRENE), AS PER PLAN

*At existing bolster locations

TOTAL NUMBER OF BEARINGS REPLACED (EA); T_{FIXED} **= 14**

ITEM 518 – POROUS BACKFILL WITH GEOTEXTILE FABRIC

*Item includes 2’-0” thick porous backfill behind backwalls

Proposed approach slab thickness (ft); t_{app} = **1.417**

Abutment length (ft); L_{abut} = **62.167**

Average backwall height RA (ft); h_{RA} = **7.198**

Average backwall height FA (ft); h_{FA} = **7.005**

Additional excavation below backwall for new porous backfill (ft); h’ = **2.000**

Porous backfill thickness (ft); t_{518} = 2

TOTAL VOL POROUS BACKFILL (CY); T_{518} = ceiling(L_{abut} × ((h_{RA} + h’) + (h_{FA} + h’) – 2 × t_{app}) × t_{518} / 27, 1) = **71.000**

ITEM 519 – PATCHING CONCRETE STRUCTURE, AS PER PLAN

*From repair plan

TOTAL PATCHING AREA (SF); $T_{patch} = 383$

ITEM 519 – COMPOSITE FIBER WRAP SYSTEM

*See calculation for Item 512 – Urethane Top Coat Sealer

TOTAL FIBER WRAP AREA (SQ FT); $\mathbf{A_{fiber} = A_{urethane} \times 9 = 5184.000}$

ITEM 526 – REINFORCED CONCRETE APPROACH SLABS WITH QC/QA (T=17”), AS PER PLAN

*Approach slabs with integral sidewalk

Length of approach slabs (Ft); L_{app} = **30.000**

Rear approach slab width(ft); W_{rear_app} = **62.500**

Fwd approach slab plan area (CAD) (sq ft); A_{fwd_app} = 1967.7

TOTAL APPROACH SLAB AREA (SQ YD); $A_{app} = \text{ceiling}((L_{app} \times W_{rear\_app} + A_{fwd\_app}) / 9, 1)$ = **427.000**

ITEM 526 – TYPE C INSTALLATION, AS PER PLAN

*See calculation form Item 516 – Armorless Preformed Joint Seal

TOTAL INSTALLATION LENGTH (FT); $\mathbf{L_{install} = L_{PJS} = 126.000}$

ITEM 601 – CONCRETE SLOPE PROTECTION, AS PER PLAN

*At undermined area at rear abutment

*Include subgrade placement and compaction, and polystyrene backer and silicone sealer at breastwall joint with this item.

Concrete panel area (sq ft); A_{panel} = **25.000**

Panels to be replaced (each); N_{repl} = **15.000**

TOTAL AREA OF SLOPE PROTECTION REMOVED (SQ YD); $\mathbf{T_{SP\_REM} = ceiling(A_{panel} \times N_{repl} / 9, 1) = 42.000}$

ITEM 607 – VANDAL PROTECTION FENCE, 6' STRAIGHT, COATED FABRIC **---- OR ----**

ITEM 607 – FENCE, MISC.: DECORATIVE VANDAL PROTECTION FENCE

Proposed bridge limits (ft); L_{deck} = **414.417**

SW Wingwall length (ft); L_{sw} = **41.750**

SE Wingwall length (ft); L_{se} = **32.250**

NW Wingwall length (ft); L_{nw} = **37.250**

NE Wingwall length (ft); L_{ne} = **23.250**

Fence on SW Wingwall (ft); $F_{sw} = L_{sw} - 11/12 =$ **40.833**

Fence on SE Wingwall (ft); $F_{se} = L_{se} - 1.4167 =$ **30.833**

Fence on NW Wingwall (ft); $F_{nw} = L_{nw} - 10/12 =$ **36.417**

Fence on NE Wingwall (ft); $F_{ne} = L_{ne} - 10/12 =$ **22.417**

TOTAL LENGTH OF FENCE (FT); $T_{VPF} = \text{ceiling}((2 \times L_{deck} + F_{sw} + F_{se} + F_{nw} + F_{ne}), 1) =$ **960.000**

ITEM 607 - TEMPORARY VANDAL FENCE, TYPE B

*At PCB during phase construction on bridge deck only.

Proposed bridge limits (ft); L_{deck} = **414.417**

TOTAL LENGTH OF TEMPORARY FENCE (FT); $\mathbf{T_{VPF\_temp}}$ **= ceiling(**$2 \times L_{deck}$ **, 1) = 829.000**

ITEM 625 – CONDUIT, 4”, 725.04, AS PER PLAN

*Item includes new City of Indpendence, Windstream, Crown Castle, Century Link and Charter conduits.

Windstream: Conduit limits - 3’ beyond each backwall; $L_{wind} = 2 \times 425 =$ **850.000**

COI: Conduit limits – JB @ Sta. 106+08.22 to 111+25.00; $L_{COI} = 2 \times (11125\text{-}10608.22) =$ **1033.560**

Crown Castle: Conduit limits - 3’ beyond each backwall; $L_{crwn} = 2 \times 425 =$ **850.000**

Centurylink: Conduit limits - 3’ beyond each backwall; $L_{ctlk} = 1 \times 425 =$ **425.000**

Charter Comm.: Conduit limits – 3’ beyond each backwall; $L_{chtr} = 1 \times 425 =$ **425.000**