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Item 202 – Approach Slab Removed

Existing Approach slab width (ft); $W_{ex\_app} = 20$

Existing approach slab length (ft); $L_{ex\_app} = 15$

Total Area of 202 (SY); $T_{ex\_app} = \text{ceiling}(2 \times W_{ex\_app} \times L_{ex\_app} / 9, 1) = \mathbf{67.000}$

Item 202 – Wearing Surface Removed

*See calculation for Item 202 – Approach Slab Removed

*Included with Roadway Quantities on General Summary sheet.

Total Area of 202 (SY); $T_{ex\_ws} = T_{ex\_app} = 67.000$

Item 503 – Unclassified Excavation

*Unclassified excavation includes areas required for construction of new abutments.

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

Proposed abutment footing width (ft); $w_{ftg} = 4.5$

Proposed abutment stem width (ft); $w_{stem} = 3$

Excavation limit behind abutment footing (ft); $e_b = w_{PB} - (w_{ftg} - w_{stem}) / 2 =$ **1.250**

Excavation limit in front of proposed abutment to back of existing abutment (Ft); $e_f = 7.3$

Removal limit of existing RA (ft); $EL_{rem\_RA} = 817.68$

Removal limit of existing FA (ft); $EL_{rem\_FA} = 817.00$

Proposed B/Ftg RA (ft); $EL_{ftg\_RA} = 818.43$

Proposed B/Ftg FA (ft); $EL_{ftg\_FA} = 817.80$

Proposed abut height – RA (ft); $h_{avg\_RA} = 828.57 - EL_{ftg\_RA} =$ **10.140**

Proposed abut height – FA (ft); $h_{avg\_FA} = 827.94 - EL_{ftg\_FA} =$ **10.140**

Abutment length (ft); $L_{abut} = 39$

Wingwall length (ft); $L_{WW} = 12.57$

Area of 503 at rear abutment (sq ft); $A_{503\_RA} = (w_{ftg} + 1 + e_b) \times (h_{avg\_RA}) + 0.5 \times (e_f - 1) \times abs(EL_{rem\_RA} - EL_{ftg\_RA}) + (e_f - 1) \times (828.57 - max(EL_{ftg\_RA}, EL_{rem\_RA})) =$ **134.690**

Area of 503 at forward abutment (sq ft); $A_{503\_FA} = (w_{ftg} + 1 + e_b) \times (h_{avg\_FA}) + 0.5 \times (e_f - 1) \times abs(EL_{rem\_FA} - EL_{ftg\_FA}) + (e_f - 1) \times (827.94 - max(EL_{ftg\_FA}, EL_{rem\_FA})) =$ **134.847**

TOTAL VOLUME (CY); $T_{503} = ceiling((A_{503\_RA} + A_{503\_FA}) \times (L_{abut} + 2 \times L_{WW}) / 27,1) =$ **641.000**

Item 509 – Epoxy Coated Reinforcing Steel, As Per Plan

Abutments

Abutment & wingwall rebar (lb); $T_{509\_abut} = 7184$

Piers

Pier rebar (lb) (lb); $T_{509\_pier} = 11951$

Superstructure

Deck & diaphragm (lb); $T_{509\_super} = 62634$

Parapet

Parapet rebar (lb); $T_{509\_par} = 11618$

TOTAL WEIGHT OF REINFORCING STEEL (LB); $\mathbf{T_{509} = T_{509\_abut} + T_{509\_pier} + T_{509\_super} + T_{509\_par} = 93387.000}$

ITEM 511 – SEMI-INTEGRAL DIAPHRAGM GUIDE

* 1 per abutment

TOTAL NUMBER OF DIAPHRAGM GUIDES (EACH); **$T_{511guide}$ = 2**

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

**Includes Bridge deck, haunch, additional cantilever thickness, and semi-integral diaphragm concrete.*

Primary Deck

Proposed deck width (ft); w_{deck} = **35.330**

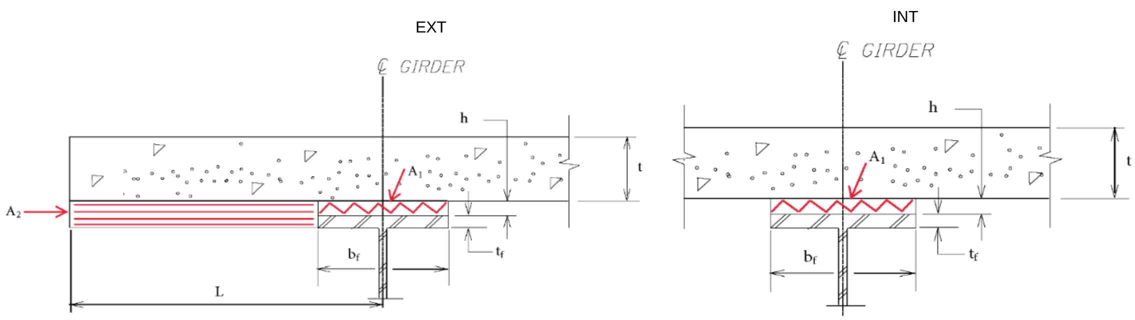
Proposed bridge limits (ft); L_{deck} = **197.210**

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

Volume of primary deck (cu ft); $V_{deck} = (w_{deck} \times L_{deck} \times t_{deck} / 12)$ = **5080.417**

Haunches

Average haunch (all beams) (in); h_{avg} = 2.08



Top flange width W36X210 (ft); b_f = 12.2/12 = **1.017**

Average flange thickness (weighted over length for W36x210 & W36x150 beams) (in);

$t_f = ((1.36 \times 168) + (0.94 \times 27)) / (168+27)$ = **1.302**

Fascia overhang (ft); L_{fascia} = 3.416667

Number of interior beams (each); N_{int} = 2

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

Haunch volume – interior beams (cu ft); $V_{haunch\_int} = b_f \times (h_{avg}/12) \times L_{deck} \times N_{int}$ = **69.506**

Haunch volume – fascia beams (cu ft); $V_{haunch\_ext} = (b_f \times (h_{avg}/12) + (L_{fascia} - (b_f / 2)) \times ((h_{avg} + t_f)/12)) \times L_{deck} \times N_{ext}$ = **392.783**

Abutment Diaphragms

Proposed abutment stem width (ft); w_{stem} = **3.000**

Abutment length (ft); L_{abut} = **39.000**

W36x210 beam CS Area (sq ft / ft); A_{36x210} = 61.8/144 = **0.429**

W36x210 beam height (ft); h_{36x210} = 36.7/12 = **3.058**

Beam length into diaphragm (ft); L_{diaph_stl} = 2

Proposed approach slab thickness (ft); t_{app} = 13/12 = **1.083**

Diaphragm height (ft); $h_{diaph} = (t_{deck} + h_{avg})/12 + h_{36x210} + 9/12$ = **4.711**

Diaphragm Volume (not including deck concrete) (cu ft); $V_{diaph} = 2 \times (w_{stem} \times (h_{diaph} - (t_{deck} + h_{avg})/12) \times L_{abut} - 2 \times A_{36x210} \times L_{diaph\_stl} \times (N_{int} + N_{ext})) =$ **877.417**

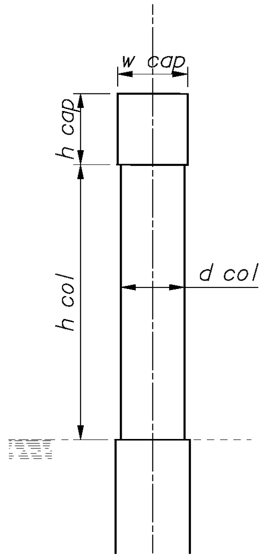
TOTAL VOLUME OF CONCRETE (CU YD); $\mathbf{T_{511deck} = ceiling((V_{deck} + V_{haunch\_int} + V_{haunch\_ext} + V_{diaph})/ 27, 5) = 240.000}$

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

Proposed length (ft);	$L_{barrier} = 229.09$
Proposed barrier with typical section (ft);	$L_{barrier\_typ} = L_{barrier} - 2 \times 14 =$ **201.090**
Parapet height (ft);	$h_{bar} = 3.5$
Parapet width (ft);	$w_{bar} = 1.5$
Parapet level width (ft);	$w_{bar\_level} = 10/12 =$ **0.833**
Typical parapet section area (sq ft);	$A_{par} = (0.5 \times (w_{bar} - w_{bar\_level}) + w_{bar\_level}) \times h_{bar} =$ **4.083**
SBR-1-13 transition volume (cu yd);	$V_{bar\_trans} = 1.82$
TOTAL VOLUME OF CONCRETE (CU YD);	**T_{511par} = ceiling(($A_{par} \times 2 \times L_{barrier\_typ}$) / 27 + 4 × V_{bar_trans}, 5) = 70.000**

40

ITEM 511 – CLASS QC1 CONCRETE WITH QC/QA, PIERS ABOVE FOOTING



Piers

Pier cap length (ft);	L_{cap} = 35.88
Pier cap width (ft);	w_{cap} = 3
Pier cap average height (ft);	h_{cap} = 3.58
Number of columns per pier;	N_{col} = 3
Pier column diameter (ft);	d_{col} = 3
Pier 1 column height (ft);	h_{col1} = 11.05
Pier 2 column height (ft);	h_{col2} = 10.79

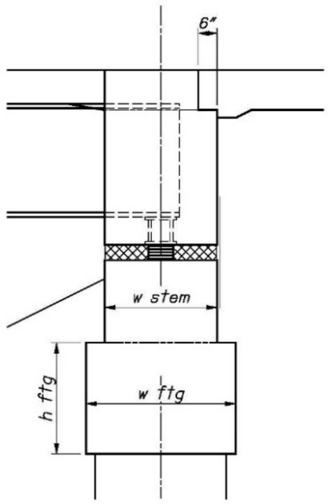
Volume Pier 1 (cu ft); $V_{P1} = ((L_{cap} - d_{col}) + pi() \times d_{col}^2 / 4) \times w_{cap} \times h_{cap} + N_{col} \times h_{col1} \times pi() \times d_{col}^2 / 4$ = **663.371**

Volume Pier 2 (cu ft); $V_{P2} = ((L_{cap} - d_{col}) + pi() \times d_{col}^2 / 4) \times w_{cap} \times h_{cap} + N_{col} \times h_{col2} \times pi() \times d_{col}^2 / 4$ = **657.858**

Total Vol of concrete for Piers (CY); $T_{511pier}$ **= ceiling((**$V_{P1} + V_{P2}$)/ 27, 5) = **50.000**

ITEM 511 – CLASS QC1 CONCRETE WITH QC/QA, ABUTMENT INCLUDING FOOTING

**Includes footing and stem concrete. Semi-integral diaphragm concrete is included with Bridge Deck Concrete Item.*



Abutment length (ft); L_{abut} = **39.000**

Proposed abutment footing width (ft); w_{ftg} = **4.500**

Proposed abutment stem width (ft); w_{stem} = **3.000**

Height of footing (ft); h_{ftg} = 3

Rear Abutment

Abut stem height – RA (ft); h_{RA_stem} = 823.61 – 818.43 – 3 = **2.180**

Volume RA (cu ft); $V_{RA} = L_{abut} \times (h_{RA\_stem} \times w_{stem} + w_{ftg} \times h_{ftg})$ = **781.560**

Forward Abutment

Abut stem height – FA (ft); h_{FA_stem} = 822.98 – 817.80 – 3 = **2.180**

Volume FA (cu ft); $V_{FA} = L_{abut} \times (h_{FA\_stem} \times w_{stem} + w_{ftg} \times h_{ftg})$ = **781.560**

Wingwalls

Wingwall stem width (ft); w_{WW} = 2.5

NW & SE wingwall average level length (ft); L_{WW_1avg} = 3

NE & SW wingwall average level length (ft); L_{WW_2avg} = 2.79

NW wingwall average ht (ft); H_{WW_NW} = (827.67 + 823.55) / 2 – 820.80 = **4.810**

NE wingwall average ht (ft); H_{WW_NE} = (827.72 + 824.38) / 2 – 820.80 = **5.250**

SW wingwall average ht (ft); H_{WW_SW} = (828.30 + 823.93) / 2 – 821.43 = **4.685**

SE wingwall average ht (ft); H_{WW_SE} = (828.35 + 824.22) / 2 – 821.43 = **4.855**

Vol for NW wingwall (cu ft); $V_{NW} = ((w_{WW} \times H_{WW\_NW}) \times 9.35 + L_{WW\_1avg} \times (827.67 - 820.80) + (w_{ftg} \times h_{ftg}) \times (L_{WW\_1avg} + 10))$ = **308.544**

Vol for NE wingwall (cu ft); $V_{NE} = ((w_{WW} \times H_{WW\_NE}) \times 10 + L_{WW\_2avg} \times (827.72 - 820.80) + (w_{ftg} \times h_{ftg}) \times (L_{WW\_2avg} + 10))$ = **323.222**

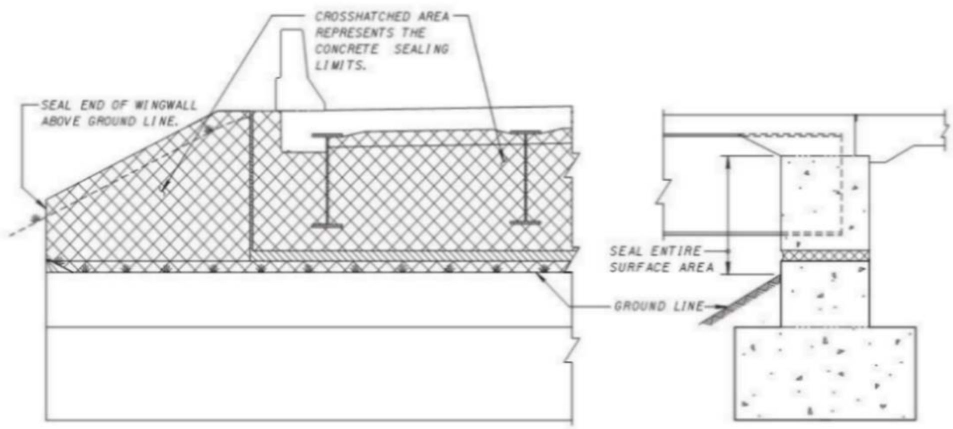
Vol for SW wingwall (cu ft); $V_{SW} = ((w_{WW} \times H_{WW\_SW}) \times 10 + L_{WW\_2avg} \times (828.30 - 821.43) + (w_{ftg} \times h_{ftg}) \times (L_{WW\_2avg} + 10))$ = **308.957**

Vol for SE wingwall (cu ft); $V_{SE} = ((w_{WW} \times H_{WW\_SE}) \times 9.35 + L_{WW\_1avg} \times (828.35 - 821.43) + (w_{ftg} \times h_{ftg}) \times (L_{WW\_1avg} + 10))$ = **309.746**

Total Vol of concrete for abutments (CY); T_{511sub} = **ceiling(**$(V_{RA} + V_{FA} + V_{NW} + V_{NE} + V_{SW} + V_{SE})/ 27, 5)$ = **105.000**

ITEM 512 – SEALING CONCRETE SURFACES (EPOXY-URETHANE)

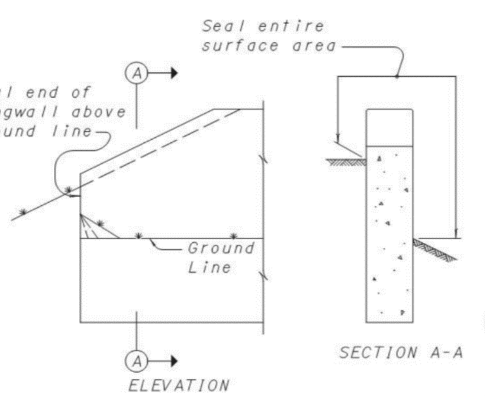
Abutments



ABUTMENT SEALING LIMITS
(FOR SEMI-INTEGRAL ABUTMENT STEEL BEAM BRIDGE)

Diaphragm height (ft);	h_{diaph} = **4.711**
Bearing height (ft);	h_{brg} = 2.356 / 12 = **0.196**
Proposed approach slab thickness (ft);	t_{app} = **1.083**
Beam seat-to-ground clearance (ft);	h_{clr} = 0.5
Abutment sealed height (ft);	$H_{512\_A} = h_{diaph} - t_{app} + h_{brg} + h_{clr}$ = **4.324**
Abutment length (ft);	L_{abut} = **39.000**
Total abutment area (sq ft);	$A_{512\_abut} = 2 \times H_{512\_A} \times L_{abut}$ = **337.259**

Wingwalls



ITS WINGWALL SEALING LIMITS
(STRAIGHT WING ABUTMENT)

*Wingwall sealing areas measured in CAD. Generally equation is as follows:

Area = River side face + Embankment side face + Top area + End Area

SW Wingwall elevation area (CAD) (sq ft); $A_{512\_SW} = 46.2 + 10.29 + (13.76 \times 2.5) + (1.12 \times 2.5) = \mathbf{93.690}$

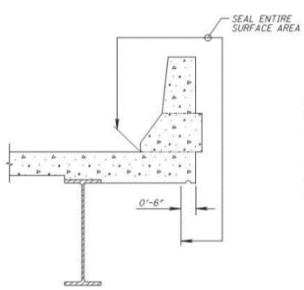
SE Wingwall elevation area (CAD) (sq ft); $A_{512\_SE} = 48.3 + 5.25 + (13.23 \times 2.5) + (1.29 \times 2.5) = \mathbf{89.850}$

NW Wingwall elevation area (CAD) (sq ft); $A_{512\_NW} = 47.58 + 5.80 + (13.23 \times 2.5) + (1.25 \times 2.5) = \mathbf{89.580}$

NE Wingwall elevation area (CAD) (sq ft); $A_{512\_NE} = 51.9 + 5.7 + (13.4 \times 2.5) + (2.6 \times 2.5) = \mathbf{97.600}$

Total wingwall area (sq ft); $A_{512\_ww} = A_{512\_SW} + A_{512\_SE} + A_{512\_NW} + A_{512\_NE} = \mathbf{370.720}$

Deck and Parapet (on bridge deck)



CONCRETE DECK WITH DEFLECTOR PARAPET

**** ODOT D3 preference is to seal to the edge of the beam flange *****

Parapet height (ft); $h_{bar} = 3.5$

Parapet width (ft); $w_{bar} = 1.5$

Parapet level width (ft); $w_{bar\_level} = 10/12 = \mathbf{0.833}$

Proposed bridge limits (ft); $L_{deck} = \mathbf{197.210}$

Parapet perimeter (ft); $perim_{bar} = h_{bar} + w_{bar\_level} + \sqrt{((w_{bar} - w_{bar\_level})^2 + h_{bar}^2)} = \mathbf{7.896}$

Average haunch (all beams) (in); $h_{avg} = \mathbf{2.080}$

Average flange thickness (weighted over length) (in); $t_f = \mathbf{1.302}$

Width of deck overhang sealed (ft); $w_{fascia} = (L_{fascia} - b_f / 2) = \mathbf{2.908}$

Sealing perimeter (ft); $P_{deck} = perim_{bar} + (h_{avg} + t_f + t_{deck}) / 12 + w_{fascia} = \mathbf{11.816}$

Total sealing area on bridge deck (sq ft); $A_{512\_deck} = P_{deck} \times L_{deck} \times 2 = \mathbf{4660.301}$

Parapets (on approach slabs)

*Parapet perimeter only

Perimeter of parapet (ft); $perim_{bar} = \mathbf{7.896}$

Length of parapet on approach slabs (ft); $L_{bar\_app} = 15.9$

End area of parapet transition (sq ft); $A_{par\_end} = 2.33 \times 10/12 + 8/12 \times 4/12 = \mathbf{2.164}$

Total sealing area of parapets on approaches (sq ft); $A_{512\_par} = 4 \times (A_{par\_end} + perim_{bar} \times L_{bar\_app}) = \mathbf{510.858}$

TOTAL AREA OF SEALING (SY); $\mathbf{T_{512} = ceiling((A_{512\_abut} + A_{512\_ww} + A_{512\_deck} + A_{512\_par}) / 9, 5) = 655.000}$

ITEM 512 – TYPE B WATERPROOFING

*3' wide at wingwall horizontal construction joint

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

Wingwall length (ft); $L_{WW} = \mathbf{12.570}$

Total Area of Type B Waterproofing (SY); $\mathbf{A_{Type2} = ceiling((4 \times W_{TypeB} \times L_{WW}) / 9, 1) = 17.000}$

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ITEM 513 – STRUCTURAL STEEL MEMBERS, LEVEL 3, AS PER PLAN

Main Steel Members

Length from CL brg to first field splice (ft); L_{sp1} = 57 + 16.5 + 0.5 = **74.000**

Length from splice to splice (ft); L_{sp2} = 81 – 16.5 – 16.5 = **48.000**

Length from splice to CL brg (ft); L_{sp3} = 57+ 16.5 +0.5 = **74.000**

Number of interior beams (each); N_{int} = 2

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

Total Number of beams (each); $N_{beams} = N_{int} + N_{ext}$ = **4.000**

Unit Weight of W36x210 (lb/ft); W_{36x210} = 210

Unit Weight of W36x150 (lb/ft); W_{36x150} = 150

Unit weight of field splice (lb/splice); W_{splice} = 510

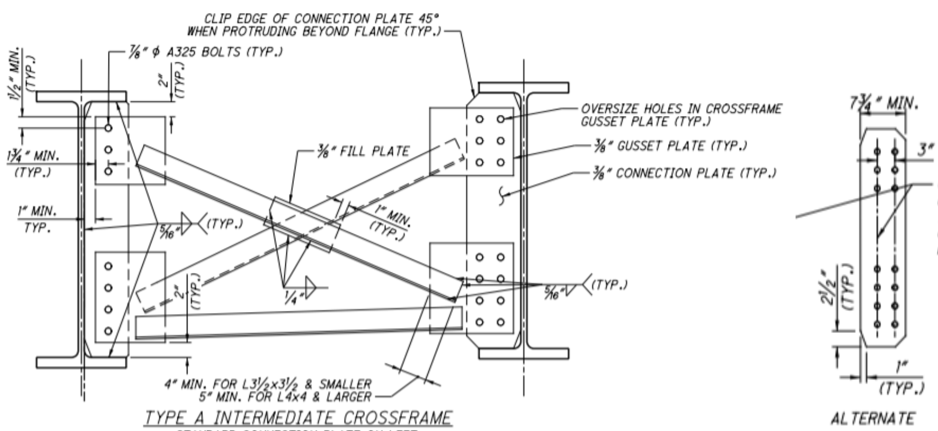
Unit weight of optional field splice (lb/splice); W_{splice_opt} = 910

Total Weight of Main Steel Members (lb); $W_{stl\_main} = N_{beams} \times (2 \times W_{splice} + W_{splice\_opt} + W_{36x210} \times (L_{sp1} + L_{sp3}) + W_{36x150} \times L_{sp2})$ = **160840.000**

Standard Crossframes

**Per GSD-1-19 Designer Supplement, Estimated quantities are to assume the use of Type A Crossframes*

**For 3'-5" overhang and 9'-6" beam spacing, angles will be L5x5x1/2 and the alternate connection plates will be used.*



Gusset & Connection plate thickness (in); t_{pl} = 0.375

Connection plate width (in); w_{conn} = 7.75

Unit weight of L5x5x1/2 angles (lb/ft); W_{5x5} = 16.2

Leg length of angles (in); l_a = 5

Typical clear distance (in); clr = 1

Typical bolt spacing (in); spa_b = 3

Bolt horizontal edge distance (in); $edge_h$ = 1.75

Bolt vertical edge distance (in); $edge_v$ = 1.5

Unit weight of steel plates (lb/ft^3); W_{stl} = 490

Beam spacing (ft); S_{bm} = 9.5

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W36x210 beam height (ft); h_{36x210} = **3.058**

W36X210 flange width (ft); b_f = **1.017**

W36x210 flange thickness (ft); t_{f_36x210} = 1.26/12 = **0.105**

W36x210 web thickness (ft); t_{w_36x210} = 0.83/12 = **0.069**

W36x150 beam height (ft); h_{36x150} = 35.9/12 = **2.992**

W36X150 flange width (ft); b_{f_36x150} = 12.2/12 = **1.017**

W36x150 flange thickness (ft); t_{f_36x150} = 0.79/12 = **0.066**

W36x150 web thickness (ft); t_{w_36x150} = 0.60/12 = **0.050**

Gusset plate area extend horizontally 6" past connection plate to achieve 5" weld on bottom horizontal angle

Bottom gusset plate area (sq ft); $A_{bg} = (6+w_{conn} - clr) \times (3+(3\times spa_b)+edge_v) / 144$ = **1.195**

Top gusset plate area (sq ft); $A_{tg} = (6+w_{conn} - clr) \times (3+(2\times spa_b)+edge_v) / 144$ = **0.930**

Connection plate area (sq ft); $A_{conn} = w_{conn} / 12 \times (h_{36x210} - 2\times t_{f\_36x210})$ = **1.840**

Horizontal angle length (ft); $L_{a\_h} = S_{bm} - t_{w\_36x210}/12 - 2 \times (w_{conn} + clr)/12$ = **8.036**

Diagonal angle vertical dimension (ft); $vert_{dia} = h_{36x210} - 2\times t_{f\_36x210} - (2 + clr + l_a + clr)/12 - (2 + clr + l_a)/12$ = **1.432**

Diagonal angle length (ft); $L_{a\_dia} = \sqrt{(L_{a\_h}^2 + vert_{dia}^2)}$ = **8.162**

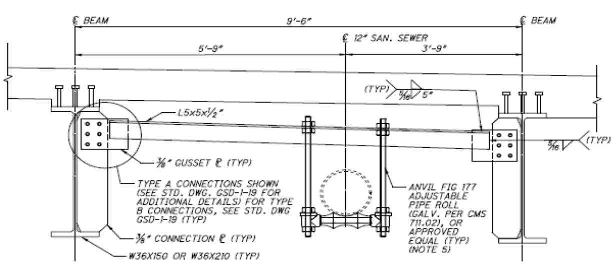
Weight per standard cross-frame (lb); $W_{cf} = 1.05 \times (W_{5x5} \times (L_{a\_h} + 2\times L_{a\_dia}) + 2 \times W_{stl} \times t_{pl} \times (A_{bg} + A_{tg} + A_{conn}) / 12)$ = **541.862**

(*includes 5% for fill plate and bolts*)

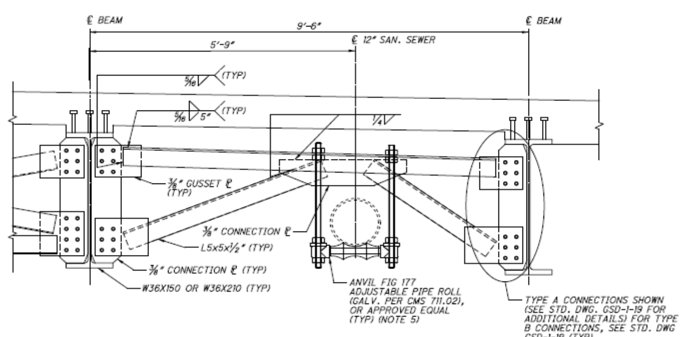
Total number of standard crossframes; N_{scf} = 38

Total standard crossframe weight (lb); $W_{stl\_scf} = N_{scf} \times W_{cf}$ = **20590.752**

<u>Special Pipe Support Crossframes</u>



MODIFIED CROSSFRAME SECTION TYPE 1



MODIFIED CROSSFRAME SECTION TYPE 2

Top gusset plate area (sq ft); A_{tg} = **0.930**

Connection plate area (sq ft); A_{conn} = **1.840**

Horizontal angle length (ft); L_{a_h} = **8.036**

Weight per special crossframe 1 cross-frame (lb); $W_{cf1} = 1.05 \times (W_{5x5} \times L_{a\_h} + 2 \times W_{stl} \times t_{pl} \times (A_{tg} + A_{conn}) / 12) =$ **225.739**
(*includes 5% for fill plate and bolts*)

Diagonal angle vertical dimension (ft); $vert_{dia12} = h_{36x210} - 2\times t_{f\_36x210} – (2 + clr + l_a)/12 – (2 + clr)/12 =$ **1.932**
Diagonal angle 1 horizontal dimension (ft); $horiz_{dia1} = 5.75 - t_{w\_36x210}/2/12 - (w_{conn} + clr)/12 – 10/12 =$ **4.185**
Diagonal angle 2 horizontal dimension (ft); $horiz_{dia2} = 3.75 - t_{w\_36x210}/2/12 - (w_{conn} + clr)/12 – 7/12 =$ **2.435**

Diagonal angle 1 length (ft); $L_{a\_dia1} = \sqrt{(vert_{dia12}^2 + horiz_{dia1}^2)} =$ **4.609**
Diagonal angle 2 length (ft); $L_{a\_dia2} = \sqrt{(vert_{dia12}^2 + horiz_{dia2}^2)} =$ **3.108**

Weight per special crossframe 2 cross-frame (lb); $W_{cf2} = 1.05 \times (W_{5x5} \times (L_{a\_h} + L_{a\_dia1} + L_{a\_dia2}) + 2 \times W_{stl} \times t_{pl} \times (A_{tg} + A_{conn} + 1.65) / 12) =$ **410.059**
(*includes 5% for fill plate and bolts*)

Total number of Special Pipe Crossframe 1; $N_{pcf1} = 2$
Total number of Special Pipe Crossframe 2; $N_{pcf2} = 18$

Total special pipe crossframe weight (lb); $W_{stl\_pcf} = N_{pcf1} \times W_{cf1} + N_{pcf2} \times W_{cf2} =$ **7832.546**

TOTAL WEIGHT OF STEEL (LB); **T_{513} = ceiling($W_{stl\_main} + W_{stl\_scf} + W_{stl\_pcf}$, 1) = 189264.000**

ITEM 513 – WELDED SHEAR STUD CONNECTORS

Studs per location; $stud = 3$

Studs per beam; N_{stud} = 68 +49+29+29+50+67=**292.000**

Number of interior beams (each); N_{int} = **2.000**

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

TOTAL NUMBER OF SHEAR STUDS (EA); $\mathbf{T_{stud} = stud \times N_{stud} \times (N_{int} + N_{ext}) = 3504.000}$

ITEM 514 – FIELD PAINTING STRUCTURAL STEEL, INTERMEDIATE COAT

ITEM 514 – FIELD PAINTING STRUCTURAL STEEL, FINISH COAT

Number of interior beams (each); N_{int} = **2.000**

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

W36x210 beam height (ft); h_{36x210} = **3.058**

W36X210 flange width (ft); b_f = **1.017**

W36x210 flange thickness (ft); t_{f_36x210} = **0.105**

W36x210 web thickness (ft); t_{w_36x210} = **0.069**

W36x150 beam height (ft); h_{36x150} = **2.992**

W36X150 flange width (ft); b_{f_36x150} = **1.017**

W36x150 flange thickness (ft); t_{f_36x150} = **0.066**

W36x150 web thickness (ft); t_{w_36x150} = **0.050**

Length from CL brg to first field splice (ft); L_{sp1} = **74.000**

Length from splice to splice (ft); L_{sp2} = **48.000**

Length from splice to CL brg (ft); L_{sp3} = **74.000**

W36x210 Beam Section

Length of W36x210 between abutment diaphragms per beam line (ft); $L_{36x210} = L_{sp1} + L_{sp3} - 2\times1.5$ = **145.000**

W36x210 perimeter (ft); $P_{36x210} = b_f + 2 \times (b_f - t_{w\_36x210}) + 2\times h_{36x210}$ = **9.028**

W36x150 Beam Section

Length of W36x150 between abutment diaphragms per beam line (ft); $L_{36x150} = L_{sp2}$ = **48.000**

W36x150 perimeter (ft); $P_{36x150} = b_{f\_36x150} + 2 \times (b_{f\_36x150} - t_{w\_36x150}) + 2\times h_{36x150}$ = **8.933**

Total Painting – main steel members (sq ft); $T_{514\_main} = N_{beams} \times (P_{36x210} \times L_{36x210} + P_{36x150} \times L_{36x150})$ = **6951.633**

Crossframes

From Steel weight calc

Bottom gusset plate area (sq ft); A_{bg} = **1.195**

Top gusset plate area (sq ft); A_{tg} = **0.930**

Connection plate area (sq ft); A_{conn} = **1.840**

Gusset & Connection plate thickness (in); t_{pl} = **0.375**

Leg length of angles (in); l_a = **5.000**

Horizontal angle length (ft); L_{a_h} = **8.036**

Diagonal angle length (ft); L_{a_dia} = **8.162**

Crossframes per bay; N_{cf} = **16.000**

Perimeter of L5x5x1/2 angles (ft); $P_{5x5} = (5+5+0.5+4.5+4.5+0.5) / 12$ = **1.667**

Painted area of crossframe gusset and connection plates (sq ft)

Assumes ½ of each gusset plate is covered in connection plate painting area overlap, overlap of angle and gusset plate not considered, plate edge thickness not considered;

$A_{514\_pl} = 2 \times A_{conn} + 0.5 \times 2 \times A_{bg} + 0.5 \times 2 \times A_{tg}$ = **5.804**

Painted area of crossframe angle members (sq ft); $A_{514\_a} = P_{5x5} \times (L_{a\_h} + 2 \times L_{a\_dia}) – 6 \times l_a \times 5 / 144$ = **39.560**

Total Painting – crossframe members (sq ft); $T_{514\_cf} = (N_{beams} - 1) \times N_{cf} \times (A_{514\_pl} + A_{514\_a})$ = **2177.459**

TOTAL AREA OF PAINTING (SQ FT); **T_{514} = ceiling($T_{514\_main} + T_{514\_cf}$, 1) = 9130.000**

ITEM 514 – FINAL INSPECTION REPAIR

*Per CMS, one location per 150 linear foot of girder

Length of beams (ft); L_{beam} = **195.000**

Number of interior beams (each); N_{int} = **2.000**

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

Number of locations per beam line (each); N_{inspec} = ceiling(L_{beam} / 150, 1) = **2.000**

TOTAL NUMBER OF INSPECTION LOCATIONS (EA); $T_{insp} = (N_{int} + N_{ext}) \times N_{inspec}$ = 8.000

ITEM 514 – FIELD PAINTING MISC.: EXISTING SANITARY PIPE

*Includes surface prep and priming for existing pipe remaining.

Length of existing pipe to remain (ft); L_{pipe_ex} = 155

OD of pipe (ft); OD_{pipe} = 12.75/12 = **1.063**

Total pipe surface area for surface prep & painting (SQ FT);

$T_{514\_ex\ pipe}$ = ceiling(pi()×OD_{pipe}^2 × L_{pipe_ex} / 4, 1) = **138.000**

ITEM 514 – FIELD PAINTING MISC.: NEW SANITARY PIPE

*Includes intermediate and finish coat for segments of new sanitary line.

Total length of pipe to be painted (ft); L_{pipe_tot} = 192

Length of existing pipe to remain (ft); L_{pipe_ex} = **155.000**

OD of pipe (ft); OD_{pipe} = **1.063**

Total new pipe surface area for intermediate and finish coat (sq ft);

$$T_{514\_pipe\_new} = \text{ceiling}(\text{pi}() \times OD_{pipe}^2 \times (L_{pipe\_tot} - L_{pipe\_ex}) / 4, 1) = 33.000$$

ITEM 516 – ARMORLESS PREFORMED JOINT SEAL

**Measured as length of sleeper slab along the bridge skew.*

Width of approach slabs at ends (ft); W_{app_curb} = **33.000**

Bridge skew; Θ = 25

Seal length along skew (ft); PJS = W_{app_curb} / cos(Θ) = **36.411**

TOTAL SEAL LENGTH (FT); **L_{SEAL} = ceiling(2 × PJS, 1) = 73.000**

ITEM 516 – 1” PREFORMED EXPANSION JOINT FILLER

**Located between approach and bridge-mounted parapet*

Typical parapet section area (sq ft); A_{par} = **4.083**

Bridge skew; Θ = **25.000**

Parapet area along skew (ft); $A_{par\_skew} = A_{par} / \cos(\Theta)$ = **4.505**

TOTAL PEJF AREA (SQ FT); $\mathbf{L_{PEJF\_1} = ceiling(A_{par\_skew} \times 4, 1) = 19.000}$

ITEM 516 – 2" PREFORMED EXPANSION JOINT FILLER

**Located between wingwall and abutment diaphragm*

Width of wingwall (ft); w_{WW} = **2.500**

Bridge skew; Θ = **25.000**

Wingwall width along skew (ft); $W_{WW\_skew} = w_{WW} / \cos(\Theta)$ = **2.758**

NW WW height at PEJF (Ft); h_{pejf_NW} = 827.67 – 822.80 = **4.870**

NE WW height at PEJF (Ft); h_{pejf_NE} = 827.71 – 822.84 = **4.870**

SW WW height at PEJF (Ft); h_{pejf_SW} = 828.30 – 823.43 = **4.870**

SE WW height at PEJF (Ft); h_{pejf_SE} = 828.35 – 823.47 = **4.880**

TOTAL PEJF AREA (SQ FT); $L_{PEJF\_2} = \text{ceiling}(W_{WW\_skew} \times (h_{pejf\_NW} + h_{pejf\_NE} + h_{pejf\_SW} + h_{pejf\_SE}), 1)$ = **54.000**

ITEM 516 – SEMI-INTEGRAL EXPANSION JOINT SEAL

Abutment length (ft); L_{abut} = **39.000**

Length of seal (ft); $L_{exp\_jt\_seal} = L_{abut} + 3 =$ **42.000**

Total Length of Semi-integral expansion joint seal (FT);

$L_{jt\_seal} = \text{ceiling}(2 \times L_{exp\_jt\_seal}, 1) = 84.000$

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

Total Number of beams (each); N_{beams} = **4.000**

TOTAL NUMBER OF ABUTMENT BEARINGS(EA); $\mathbf{T_{BRG\_abut} = N_{beams} \times 2 = 8.000}$

TOTAL NUMBER OF PIER BEARINGS(EA); $\mathbf{T_{BRG\_pier} = N_{beams} \times 2 = 8.000}$

ITEM 518 – POROUS BACKFILL WITH GEOTEXTILE FABRIC

*Item includes 2'-0" thick porous backfill behind abutments and wingwalls.

Proposed approach slab thickness (ft); t_{app} = **1.083**
Diaphragm height (ft); h_{diaph} = **4.711**
Assumed bearing height (ft); h_{brg} = **0.196**
Abutment length (ft); L_{abut} = **39.000**
Abut stem height – RA (ft); h_{RA_stem} = **2.180**
Abut stem height – FA (ft); h_{FA_stem} = **2.180**
Abut stem width (Ft); w_{stem} = **3.000**
Footing width (Ft); w_{ftg} = **4.500**
Footing height (Ft); h_{ftg}= **3.000**

Porous backfill thickness (ft); t_{518} = 2
Porous backfill area behind RA (sq ft); $A_{518\_RA} = t_{518} \times (h_{RA\_stem} + h_{brg} + h_{diaph} - t_{app}) + (t_{518} - (w_{ftg}-w_{stem})/2)\times h_{ftg}$ = **15.758**
Porous backfill area behind FA (sq ft); $A_{518\_FA} = t_{518} \times (h_{FA\_stem} + h_{brg} + h_{diaph} - t_{app}) + (t_{518} - (w_{ftg}-w_{stem})/2)\times h_{ftg}$ = **15.758**

Average Wingwall length (ft); L_{WW} = **12.570**
NW wingwall average ht above footing (ft); H_{WW_NW} = **4.810**
NE wingwall average ht above footing (ft); H_{WW_NE} = **5.250**
SW wingwall average ht above footing (ft); H_{WW_SW} = **4.685**
SE wingwall average ht above footing (ft); H_{WW_SE} = **4.855**

Porous backfill area behind NW wingwall (sq ft); $A_{518\_NW} = (H_{WW\_NW} - 1.5) \times t_{518} + (t_{518} - (w_{ftg}-w_{stem})/2)\times h_{ftg}$ = **10.370**
Porous backfill area behind NE wingwall (sq ft); $A_{518\_NE} = (H_{WW\_NE} - 1.5) \times t_{518} + (t_{518} - (w_{ftg}-w_{stem})/2)\times h_{ftg}$ = **11.250**
Porous backfill area behind SW wingwall (sq ft); $A_{518\_SW} = (H_{WW\_SW} - 1.5) \times t_{518} + (t_{518} - (w_{ftg}-w_{stem})/2)\times h_{ftg}$ = **10.120**
Porous backfill area behind SE wingwall (sq ft); $A_{518\_SE} = (H_{WW\_SE} - 1.5) \times t_{518} + (t_{518} - (w_{ftg}-w_{stem})/2)\times h_{ftg}$ = **10.460**

TOTAL VOL POROUS BACKFILL (CY); $T_{518} = \text{ceiling}((L_{abut} \times (A_{518\_RA} + A_{518\_FA}) + L_{WW} \times (A_{518\_NW} + A_{518\_NE} + A_{518\_SW} + A_{518\_SE}))/ 27, 1)$ = **66.000**

ITEM 518 – 6" PERFORATED CORRUGATED PLASTIC PIPE

*To run behind abutments and wingwalls

Abutment length (ft); L_{abut} = **39.000**

Wingwall length (ft); L_{WW} = **12.570**

TOTAL LENGTH PCPP (FT); $\mathbf{T_{PCPP} = ceiling(2 \times (L_{abut} + 2 \times L_{WW}), 1) = 129.000}$

ITEM 518 – 6" NON-PERFORATED CORRUGATED PLASTIC PIPE, INCLUDING SPECIALS

*From ends of wingwalls to outlet in slope.

NW Wingwall (ft); NP_{NW} = 12.5

NE Wingwall (ft); NP_{NE} = 17.5

SW Wingwall (ft); NP_{SW} = 11.5

SE Wingwall (ft); NP_{SE} = 15.5

TOTAL LENGTH NPCPP (FT); T_{NPCPP} **= ceiling(**$NP_{NW} + NP_{NE} + NP_{SW} + NP_{SE}$**, 5) = 60.000**

ITEM 524 – DRILLED SHAFTS, 36" DIAMETER, INTO BEDROCK

*At abutments into rock

Total number of drilled shafts per abutment; $N_{DS\_abut} = 4$

Minimum rock socket depth (ft); $d_{sock} = 10$

TOTAL LENGTH OF DS INTO ROCK (ABUT) (FT); $T_{524\_rock\_abut} = \text{ceiling}(2 \times N_{DS\_abut} \times d_{sock} , 1) = 80.000$

ITEM 524 – DRILLED SHAFTS, 42" DIAMETER, ABOVE BEDROCK

*At abutments above rock & at piers above T/rock elevation

Total number of drilled shafts per abutment; N_{DS_abut} = **4.000**

Total number of drilled shafts per pier; N_{DS_pier} = 3

Proposed top of drilled shaft - RA; EL_{T_DSra} = 818.43 + 0.25 = **818.680**

Proposed top of drilled shaft – FA; EL_{T_DSfa} = 817.80 + 0.25 = **818.050**

Top of rock elevation – RA; TR_{RA} = 811.26

Top of rock elevation – FA; TR_{FA} = 809.92

Proposed top of drilled shaft at piers; EL_{T_DSp} = 809.11

Top of rock elevation – P1; TR_{P1} = 806.69

Top of rock elevation – P2; TR_{P2} = 806.46

TOTAL LENGTH OF DS ABOVE ROCK (FT); $\mathbf{T_{524\_ABOVE} = ceiling(N_{DS\_abut} \times (EL_{T\_DSra} - TR_{RA} + EL_{T\_DSfa} - TR_{FA}) + N_{DS\_pier} \times (EL_{T\_DSp} - TR_{P1} + EL_{T\_DS} - TR_{P2}), 1) = 78.000}$

ITEM 524 – DRILLED SHAFTS, 42" DIAMETER, INTO BEDROCK

* At pier columns

Total number of drilled shafts per pier; N_{DS_pier} = **3.000**

Minimum rock socket depth at piers (ft); d_{sock_pier} = 12

TOTAL LENGTH OF DS INTO ROCK (PIER) (FT); $T_{524\_rock\_pier}$ = ceiling(2 × N_{DS_pier} × d_{sock_pier} , 1) = 72.000

ITEM 526 – REINFORCED CONCRETE APPROACH SLABS WITH QC/QA (T=13"), AS PER PLAN

Length of approach slabs with barrier (Ft); L_{bar_app} = **15.900**

Width of approach slabs with barrier (ft); $W_{app\_bar} = 32 + 1.67 + 1.67 =$ **35.340**

Length of approach slabs with curb (Ft); $L_{app\_curb} = 20 - L_{bar\_app} =$ **4.100**

Width of approach slabs with curb (ft); $W_{app\_curb} = 33$

TOTAL APPROACH SLAB AREA (SQ YD); $A_{app} = \text{ceiling}(2 \times (L_{bar\_app} \times W_{app\_bar} + L_{app\_curb} \times W_{app\_curb}) / 9, 1) =$ **155.000**

ITEM 526 – Type C Installation

**Measured as length of sleeper slab along the bridge skew.*

Width of approach slabs at ends (ft); W_{app_curb} = **33.000**

Bridge skew; Θ = **25.000**

Sleeper slab length along skew (ft); SS = W_{app_curb} / cos(Θ) = **36.411**

TOTAL INSTALLATION LENGTH (FT); **$L_{install}$ = ceiling(2 × SS, 1) = 73.000**

ITEM 601 – ROCK CHANNEL PROTECTION, TYPE C

*At forward abutment

*Included with Roadway Quantities on General Summary

Average bank slope; $m_{bank} = 1/5 = \mathbf{0.200}$

Plan view length of slope protection (ft); $L_{601\_plan} = 35.25$

Adjusted length of slope protection (ft); $L_{601\_adj} = \sqrt{(L_{601\_plan}^2 + (L_{601\_plan} \times m_{bank})^2)} = \mathbf{35.948}$

Width of slope protection (ft); $W_{601} = 60$

Thickness of slope protection (ft); $t_{601} = 2$

TOTAL VOLUME OF SLOPE PROTECTION (CU YD); $\mathbf{T_{SP} = ceiling(L_{601\_adj} \times W_{601} \times t_{601} / 27, 1) = 160.000}$

ITEM 838 – GABIONS, AS PER PLAN

*Included with Roadway Quantities on General Summary

Plan area of new gabions between proposed and existing rear abutment (sq ft); $A_{gab} = 927$

Estimated plan area of replacement gabions at new pier columns (sq ft); $A_{gab\_pier} = 6 \times 6 \times 3 =$ **108.000**

Estimated plan area of infill gabions at existing pier columns removed (sq ft); $A_{gab\_fill} = 6 \times 6 \times 2 =$ **72.000**

Depth of new gabions (ft); $D_{gab} = 3$

TOTAL VOLUME OF GABIONS (CU YD); $T_{GAB} = \text{ceiling}((A_{gab} + A_{gab\_pier} + A_{gab\_fill}) \times D_{gab} / 27, 1) =$ **123.000**