ESTIMATED QUANTITIES

B4180001 - IR-76 EASTBOUND OVER BROWN STREET

Units and Definitions

$\gamma_{conc} := 150pcf$ $\quad dollars := 1$ $\quad \gamma_{steel} := 490pcf$ $\quad cy := yd^3$ $\quad pcy := \frac{lbf}{cy}$ $\quad ton := 2000lbf$

STEEL BEAMS ON SEMI-INTEGRAL ABUTMENTS

Bridge Data

$L_{bridge} := 160.2083 \cdot ft$ *Bridge Limits:*

$w_{bridge.min} := 85.5521 \cdot ft$ *Min. Bridge width (O/O Deck):*

$w_{bridge.max} := 91.0938 ft$ *Max Bridge width (O/O Deck):*

$Skew := 6.9956 deg$ *Skew of Bridge*

$n_{Abuts} := 2$ *Number of Abutments*

$n_{Piers} := 2$ *Number of Piers*

Legend

INPUTS | IMPORTANT VALUES | FINAL VALUE | NEEDS UPDATED

ITEM 202E11203- PORTIONS OF STRUCTURE REMOVED, OVER 20 FOOT SPAN, AS PER PLAN **LUMP**

$Rem_{Deck.Cost} := 28 \frac{dollars}{ft^2}$ *Removal Cost of Deck (Complex) (Adjusted for Inflation)*

$Rem_{Sub.Cost} := 220 \frac{dollars}{yd^3}$ *Removal Cost of Substructure (Above Average Complex) (Adjusted For Inflation)*

$Rem_{Super.Cost} := 275 \frac{dollars}{yd^3}$ *Removal Cost of Superstructure (Adjusted for Inflation)*

$Rem_{Steel.Cost} := 275 \frac{dollars}{ton}$ *Removal Cost of Structural Steel (Adjusted for Inflation)*

Abutment Removal *Values From Exist. Plans*

Stem:

$Elev_{Ex.Beam.Seat.RA} := 1058.89\,ft$ *Elevation of Beam Seat at Removal Edge - Rear Abutment*

$Elev_{Ex.Beam.Seat.FA} := 1064.98\,ft$ *Elevation of Beam Seat at Removal Edge - Fwd Abutment*

$Elev_{Ex.Top.Foot.RA} := 1055.28\,ft$ *Elevation of Top of Footing at Removal Edge - Rear Abutment*

$Elev_{Ex.Top.Foot.FA} := 1061.53\,ft$ *Elevation of Top of Footing at Removal Edge - Fwd Abutment*

$h_{Ex.RA.Stem} := Elev_{Ex.Beam.Seat.RA} - Elev_{Ex.Top.Foot.RA}$ $h_{Ex.RA.Stem} = 3.61\ ft$ *Height of Exist. Rear Abut. Stem*

$h_{Ex.FA.Stem} := Elev_{Ex.Beam.Seat.FA} - Elev_{Ex.Top.Foot.FA}$ $h_{Ex.FA.Stem} = 3.45\ ft$ *Height of Exist. Fwd Abut. Stem*

$A_{Ex.RA.Stem} := 30.056\,ft^2$ *Plan Area of Rear Abut Stem Removal Includes Wingwall (Measured from Microstation)*

$A_{Ex.FA.Stem} := 39.365\,ft^2$ *Plan Area of Fwd Abut Stem Removal Includes Wingwall (Measured from Microstation)*

$V_{Ex.RA.Stem} := h_{Ex.RA.Stem} \cdot A_{Ex.RA.Stem}$ $V_{Ex.RA.Stem} = 4.02 \cdot yd^3$ *Volume of Rear Abutment Stem Removal*

$V_{Ex.FA.Stem} := h_{Ex.FA.Stem} \cdot A_{Ex.FA.Stem}$ $V_{Ex.FA.Stem} = 5.03 \cdot yd^3$ *Volume of Fwd Abutment Stem Removal*

$V_{Ex.Stem.Removal} := V_{Ex.RA.Stem} + V_{Ex.FA.Stem}$ $V_{Ex.Stem.Removal} = 9.05 \cdot yd^3$

Wingwalls:

$w_{Ex.Wingwall} := 1.50\,ft$ *Width of Existing Wingwalls*

$A_{Ex.RA.Wingwall} := 80.825\,ft^2$ *Area of Rear Abutment Wingwall Removal (Above Beam Seat)*

$A_{Ex.FA.Wingwall} := 104.000\,ft^2$ *Area of Fwd Abutment Wingwall Removal (Above Beam Seat)*

$V_{Ex.RA.Wingwall} := w_{Ex.Wingwall} \cdot A_{Ex.RA.Wingwall}$ $V_{Ex.RA.Wingwall} = 4.49 \cdot yd^3$ *Volume of Rear Abutment Wingwall Removal*

$V_{Ex.FA.Wingwall} := w_{Ex.Wingwall} \cdot A_{Ex.FA.Wingwall}$ $V_{Ex.FA.Wingwall} = 5.78 \cdot yd^3$ *Volume of Fwd Abutment Wingwall Removal*

$V_{Ex.Wingwall.Removal} := V_{Ex.RA.Wingwall} + V_{Ex.FA.Wingwall}$ $V_{Ex.Wingwall.Removal} = 10.27 \cdot yd^3$

Cap:

$w_{Ex.Cap} := 3.75\,ft$ *Width of Existing Semi-Integral Cap*

$A_{Ex.RA.Cap} := 9.073\,ft^2$ *Area of Rear Abutment Cap Removal (Measured from Microstation)*

$A_{Ex.FA.Cap} := 15.361\,ft^2$ *Area of Fwd Abutment Cap Removal (Measured from Microstation)*

$V_{Ex.RA.Cap} := w_{Ex.Cap} \cdot A_{Ex.RA.Cap}$ $V_{Ex.RA.Cap} = 1.26 \cdot yd^3$ *Volume of Rear Abutment Cap Removal*

$V_{Ex.FA.Cap} := w_{Ex.Cap} \cdot A_{Ex.FA.Cap}$ $V_{Ex.FA.Cap} = 2.13 \cdot yd^3$ *Volume of Fwd Abutment Cap Removal*

$V_{Ex.Cap.Removal} := V_{Ex.RA.Cap} + V_{Ex.FA.Cap}$ $V_{Ex.Cap.Removal} = 3.39 \cdot yd^3$

Abutment Total:

$V_{Abut.Removal} := V_{Ex.Stem.Removal} + V_{Ex.Wingwall.Removal} + V_{Ex.Cap.Removal}$

$V_{Abut.Removal} = 22.71 \cdot yd^3$

Superstructure Removal

Deck:

$A_{Ex.Deck.Removal} := 350.61ft^2$ *Width of Existing Bridge Deck (Measured from Microstation)*

Railing:

Eastbound:

$A_{Railing.Removal} := 4.304ft^2$ *Area of Railing Removal (Eastbound)*

$L_{EB.Railing.Removal} := 181.63ft$ *Length of Railing Removal (Eastbound)*

$V_{Transition} := 1.82yd^3$ *Volume of Standard SBR-1-13*

$V_{EB.Railing.Removal} := A_{Railing.Removal} \cdot L_{EB.Railing.Removal} + 2 \cdot V_{Transition}$ $V_{EB.Railing.Removal} = 32.59 \cdot yd^3$

Westbound:

$L_{WB.Railing.Removal} := 11.00ft$ *Length of Railing Removal (Westbound)*

$V_{WB.Railing.Removal} := \left(A_{Railing.Removal} \cdot L_{WB.Railing.Removal} + V_{Transition}\right)$ $V_{WB.Railing.Removal} = 3.57 \cdot yd^3$

Total Removal Cost

$$Total_{202.Struc.Removal.EB} := Ceil\left(\begin{matrix} V_{Abut.Removal} \cdot Rem_{Sub.Cost} + A_{Ex.Deck.Removal} \cdot Rem_{Deck.Cost} \cdots, 1000 \\ + V_{EB.Railing.Removal} \cdot Rem_{Super.Cost} \end{matrix}\right)$$

$Total_{202.Struc.Removal.EB} = 24000.00 \cdot dollars$

$Total_{202.Struc.Removal.WB} := Ceil\left(2V_{WB.Railing.Removal} \cdot Rem_{Super.Cost}, 1000\right)$

$Total_{202.Struc.Removal.WB} = 2000.00 \cdot dollars$

$Total_{202.Struct.Removal} := Ceil\left(Total_{202.Struc.Removal.EB} + Total_{202.Struc.Removal.WB}, 10000\right)$

$Total_{202.Struct.Removal} = 30000.00 \cdot dollars$

ITEM 202E22900 - APPROACH SLAB REMOVED **SY**

$A_{Ex.RA.Appr.Slab} := 382.86ft^2$ *Area of Rear Approach Slab Removal (Measured from Microstation)*

$A_{Ex.FA.Appr.Slab} := 401.14ft^2$ *Area of Fwd Approach Slab Removal (Measured from Microstation)*

$Total_{202.Appr.Removal} := Ceil\left(A_{Ex.RA.Appr.Slab} + A_{Ex.FA.Appr.Slab}, yd^2\right)$ $Total_{202.Appr.Removal} = 88.00 \cdot yd^2$

ITEM 503E11101 - COFFERDAMS AND EXCAVATION BRACING, AS PER PLAN **LS**

INPUTS FOR COST SHEET IN ESTIMATOR

$Price_{Additional.Mobilization} := 10000dollars$ Assumed additional mobilization cost

Steel Sheeting:

$L_{Sheeting} := 25ft$ *Assumed Length of Steel Sheeting*

$h_{Sheeting} := 20ft$ *Assumed Height of Steel Sheeting*

$A_{Sheeting} := 2\left(L_{Sheeting} \cdot h_{Sheeting}\right)$ $A_{Sheeting} = 1000.00 \cdot ft^2$

ITEM 503E21100 - UNCLASSIFIED EXCAVATION **CY**

Approach Slabs: Measured from Basemaps

$A_{Rear.Appr.Excavation} := 29.97ft^2$ *Section Area of Rear Approach Slab Excavation*

$A_{Fwd.Appr.Excavation} := 32.55ft^2$ *Section Area of Fwd Approach Slab Excavation*

$L_{Rear.Appr.Excavation} := 17.31ft$ *Length of Rear Approach Slab Excavation*

$L_{Fwd.Appr.Excavation} := 19.725ft$ *Length of Fwd Approach Slab Excavation*

$V_{Appr.Excav} := A_{Rear.Appr.Excavation} \cdot L_{Rear.Appr.Excavation} + A_{Fwd.Appr.Excavation} \cdot L_{Fwd.Appr.Excavation}$

$V_{Appr.Excav} = 1160.83 \cdot ft^3$

Abutments: Measured from Basemaps

$A_{RA.Excav} := 211.97ft^2$ *Plan Area of Rear Abutment Excavation*

$A_{FA.Excav} := 229.16ft^2$ *Plan Area of Forward Abutment Excavation*

$h_{RA.Min.Excav} := 3.00ft$ *Height of Rear Abutment Excavation*

$h_{RA.Max.Excav} := 7.50ft$ *Height of Rear Abutment Excavation*

$h_{FA.Min.Excav} := 1.50ft$ *Height of Fwd. Abutment Excavation*

$h_{FA.Max.Excav} := 6.50ft$ *Height of Fwd. Abutment Excavation*

$$h_{RA.Avg.Excav} := \left(\frac{h_{RA.Min.Excav} + h_{RA.Max.Excav}}{2}\right) = 5.25\ ft$$

$$h_{FA.Avg.Excav} := \left(\frac{h_{FA.Min.Excav} + h_{FA.Max.Excav}}{2}\right) = 4.00\ ft$$

$V_{Abut.Excav} := A_{RA.Excav} \cdot h_{RA.Avg.Excav} + A_{FA.Excav} \cdot h_{FA.Avg.Excav}$ $V_{Abut.Excav} = 2029.48 \cdot ft^3$

Piers: (Measured from Basemaps)

$A_{Pier.Excav} := 85.00ft^2$ *Area of Pier Footing Excavation*

$h_{Pier.1.Foot.1.Excav} := 5.00ft$

$h_{Pier.1.Foot.2.Excav} := 5.50ft$

$h_{Pier.2.Foot.1.Excav} := 5.25ft$

$h_{Pier.2.Foot.2.Excav} := 5.50ft$

$V_{Pier.Excav} := A_{Pier.Excav} \cdot (h_{Pier.1.Foot.1.Excav} + h_{Pier.1.Foot.2.Excav} + h_{Pier.2.Foot.1.Excav} + h_{Pier.2.Foot.2.Excav})$ $V_{Pier.Excav} = 1806.25 \cdot ft^3$

Total Excavation:

$Total_{503.Excavation} := Ceil(V_{Abut.Excav} + V_{Pier.Excav} + V_{Appr.Excav}, yd^3)$ $Total_{503.Excavation} = 186.00 \cdot yd^3$

ITEM 505E11100 - PILE DRIVING EQUIPMENT MOBILIZATION **LUMP**

Low-Medium Number of proposed piles so assumed Low-Medium End of Bid Histories

$Total_{505.Mobilization} := 10000dollars$

ITEM 507E00200 - STEEL PILES HP12x53, FURNISHED

FT

Elevations From Site Plan

$n_{Rear.Piles} := 6$ *Number of Piles in Rear Abutment*

$n_{P1.Piles} := 10$ *Number of Piles in Pier 1*

$n_{P2.Piles} := 10$ *Number of Piles in Pier 2*

$n_{Fwd.Piles} := 6$ *Number of Piles in Fwd. Abutment*

$Elev_{Top.Rear.Pile} := 1053.28\,ft$ *Elevation of Rear Abutment Top of Pile*

$Elev_{Top.P1.Pile} := 1040.03\,ft$ *Elevation of Pier 1 Top of Pile*

$Elev_{Top.P2.Pile} := 1040.03\,ft$ *Elevation of Pier 2 Top of Pile*

$Elev_{Top.Fwd.Pile} := 1059.53\,ft$ *Elevation of Fwd. Abutment Top of Pile*

$Elev_{Rear.Bedrock} := 1011.1\,ft$ *Pile Tip Elevation at Rear Abutment*

$Elev_{Pier.1.Bedrock} := 1005.4\,ft$ *Pile Tip Elevation at Rear Abutment*

$Elev_{Pier.2.Bedrock} := 1005.5\,ft$ *Pile Tip Elevation at Rear Abutment*

$Elev_{Fwd.Bedrock} := 1028.7\,ft$ *Pile Tip Elevation at Fwd. Abutment*

$L_{Rear.Furnished} := Ceil\left(Elev_{Top.Rear.Pile} - Elev_{Rear.Bedrock}, 5\,ft\right) + 5\,ft$ $L_{Rear.Furnished} = 50.00\ ft$

$L_{Pier.1.Furnished} := Ceil\left(Elev_{Top.P1.Pile} - Elev_{Pier.1.Bedrock}, 5\,ft\right) + 5\,ft$ $L_{Pier.1.Furnished} = 40.00\ ft$

$L_{Pier.2.Furnished} := Ceil\left(Elev_{Top.P2.Pile} - Elev_{Pier.2.Bedrock}, 5\,ft\right) + 5\,ft$ $L_{Pier.2.Furnished} = 40.00\ ft$

$L_{Fwd.Furnished} := Ceil\left(Elev_{Top.Fwd.Pile} - Elev_{Fwd.Bedrock}, 5\,ft\right) + 5\,ft$ $L_{Fwd.Furnished} = 40.00\ ft$

$$Total_{507.Piles.Furnish} := n_{Rear.Piles} \cdot L_{Rear.Furnished} + n_{Fwd.Piles} \cdot L_{Fwd.Furnished} \cdots + n_{P1.Piles} \cdot L_{Pier.1.Furnished} + n_{P2.Piles} \cdot L_{Pier.2.Furnished}$$

$Total_{507.Piles.Furnish} = 1340.00\ ft$

STATIC LOAD TEST CHECK

Static Load Testing is required when the combined length of a similar pile size and similar ultimate bearing value exceeds 10,000 ft and piles are not founded on bedrock.

Abutments: Ultimate Bearing Value = 217 kips and Pile Size = HP12X53

$$Check_{Abuts} := \begin{cases} \text{"ok"} & \text{if } \left(Total_{507.Piles.Furnish}\right) < 10000\,ft \\ \text{"NEED STATIC LOAD TESTING"} & \text{otherwise} \end{cases}$$

$Check_{Abuts} = \text{"ok"}$

ITEM 507E00250 - STEEL PILES HP12X53, DRIVEN **FT**

Elevations From Site Plan

$n_{Rear.Piles} = 6.00$ *Number of Piles in Rear Abutment*

$n_{P1.Piles} = 10.00$ *Number of Piles in Pier 1*

$n_{P2.Piles} = 10.00$ *Number of Piles in Pier 2*

$n_{Fwd.Piles} = 6.00$ *Number of Piles in Fwd. Abutment*

$Elev_{Top.Rear.Pile} = 1053.28\ ft$ *Elevation of Rear Abutment Top of Pile*

$Elev_{Top.P1.Pile} = 1040.03\ ft$ *Elevation of Pier 1 Top of Pile*

$Elev_{Top.P2.Pile} = 1040.03\ ft$ *Elevation of Pier 2 Top of Pile*

$Elev_{Top.Fwd.Pile} = 1059.53\ ft$ *Elevation of Fwd. Abutment Top of Pile*

$Elev_{Rear.Bedrock} = 1011.10\ ft$ *Pile Tip Elevation at Rear Abutment*

$Elev_{Pier.1.Bedrock} = 1005.40\ ft$ *Pile Tip Elevation at Rear Abutment*

$Elev_{Pier.2.Bedrock} = 1005.50\ ft$ *Pile Tip Elevation at Rear Abutment*

$Elev_{Fwd.Bedrock} = 1028.70\ ft$ *Pile Tip Elevation at Fwd. Abutment*

$L_{Rear.Driven} := Ceil(Elev_{Top.Rear.Pile} - Elev_{Rear.Bedrock}, 5ft)$ $L_{Rear.Driven} = 45.00\ ft$

$L_{Pier.1.Driven} := Ceil(Elev_{Top.P1.Pile} - Elev_{Pier.1.Bedrock}, 5ft)$ $L_{Pier.1.Driven} = 35.00\ ft$

$L_{Pier.2.Driven} := Ceil(Elev_{Top.P2.Pile} - Elev_{Pier.2.Bedrock}, 5ft)$ $L_{Pier.2.Driven} = 35.00\ ft$

$L_{Fwd.Driven} := Ceil(Elev_{Top.Fwd.Pile} - Elev_{Fwd.Bedrock}, 5ft)$ $L_{Fwd.Driven} = 35.00\ ft$

$Total_{507.Piles.Driven} := n_{Rear.Piles} \cdot L_{Rear.Driven} + n_{Fwd.Piles} \cdot L_{Fwd.Driven} \cdots + n_{P1.Piles} \cdot L_{Pier.1.Driven} + n_{P2.Piles} \cdot L_{Pier.2.Driven}$

$Total_{507.Piles.Driven} = 1180.00\ ft$

ITEM 509E10000 - EPOXY COATED REINFORCING STEEL **POUND**

$Total_{Rebar.Abut} := 4701lbf$

$Total_{Pier.Rebar} := 13429lbf$

$Total_{Super.Rebar.EB} := 47071lbf$

$Total_{Super.Rebar.WB} := 900lbf$

$Total_{509.Epoxy.Steel} := Total_{Rebar.Abut} + Total_{Pier.Rebar} + Total_{Super.Rebar.EB} + Total_{Super.Rebar.WB}$

$Total_{509.Epoxy.Steel} = 66101.00\ lbf$

ITEM 509E20001 - REINFORCING STEEL, REPLACEMENT OF EXISTING REINFORCING STEEL, AS PER PLAN **POUND**

$Total_{509.Replacement.Steel} := 100lbf$

ITEM 510E10000 - DOWEL HOLES WITH NONSHRINK, NONMETALLIC GROUT — EACH

$n_{RA.Dowels} := 27$ *Number of Dowel Holes in Rear Abutment*

$n_{P1.Dowels} := 10$ *Number of Dowel Holes in Pier 1*

$n_{P2.Dowels} := 10$ *Number of Dowel Holes in Pier 2*

$n_{FA.Dowels} := 27$ *Number of Dowel Holes in Fwd Abutment*

$Total_{510.Dowels} := n_{RA.Dowels} + n_{P1.Dowels} + n_{P2.Dowels} + n_{FA.Dowels}$ $Total_{510.Dowels} = 74.00$

ITEM 511E21523 - CLASS QC2 CONCRETE WITH QC/QA,SUPERSTRUCTURE, AS PER PLAN — CY

Semi-Integral Cap:

$A_{Rear.Cap} := 54.28\,ft^2$ *Face Area from Elevation View SUB.dgn Base*

$A_{Fwd.Cap} := 67.64 \cdot ft^2$ *Face Area from Elevation View SUB.dgn Base*

$w_{Cap} := 3.75\,ft$ *Width of Abutment Cap*

$V_{Rear.Cap} := A_{Rear.Cap} \cdot w_{Cap}$ $V_{Rear.Cap} = 7.54 \cdot yd^3$

$V_{Fwd.Cap} := A_{Fwd.Cap} \cdot w_{Cap}$ $V_{Fwd.Cap} = 9.39 \cdot yd^3$

$V_{Cap} := V_{Rear.Cap} + V_{Fwd.Cap}$ $V_{Cap} = 16.93 \cdot yd^3$

$A_{Deck.Min} := 15.21\,ft^2$ *Minimum Transverse Area of Bridge Deck*

$A_{Deck.Max} := 18.28\,ft^2$ *Maximum Transverse Area of Bridge Deck*

$L_{Deck} := 159.30\,ft$ *Length of Bridge Deck Along CJ*

$A_{RA.Add.Deck} := 3.602\,ft^2$ *Area of Additional Deck Concrete Above Rear Abutment Semi-Integral Cap*

$A_{FA.Add.Deck} := 3.12\,ft^2$ *Area of Additional Deck Concrete Above Fwd Abutment Semi-Integral Cap*

$L_{RA.Add.Deck} := 18.042\,ft$ *Length of Additonal Deck Concrete Above Rear Abutment Semi-Integral Cap*

$L_{FA.Add.Deck} := 21.427\,ft$ *Length of Additonal Deck Concrete Above Rear Abutment Semi-Integral Cap*

$A_{Deck.Avg} := \frac{A_{Deck.Min} + A_{Deck.Max}}{2}$ $A_{Deck.Avg} = 16.75 \cdot ft^2$

$V_{Deck} := A_{Deck.Avg} \cdot L_{Deck} + A_{RA.Add.Deck} \cdot L_{RA.Add.Deck} + A_{FA.Add.Deck} \cdot L_{FA.Add.Deck}$ $V_{Deck} = 103.68 \cdot yd^3$

$Total_{511.Deck} := Ceil\left(V_{Cap} + V_{Deck}, yd^3\right)$ $Total_{511.Deck} = 121.00 \cdot yd^3$

ITEM 511E34450 - CLASS QC2 CONCRETE WITH QC/QA, BRIDGE DECK (PARAPET) — CY

Areas Measured from CSUPER.dgn

SBR-1-13 Barrier

$A_{SBR1} := 588in^2$ *SBR-1-13 Barrier Area (From ODOT Std. Dwg)*

$L_{SBR1.Eastbound} := 209.95ft$ *Length of Barrier (Eastbound Side)*

$L_{SBR1.Westbound} := 25.00ft$ *Length of Barrier (Westbound Side)*

$V_{SBR1.Eastbound} := Ceil\left(A_{SBR1} \cdot L_{SBR1.Eastbound}, yd^3\right)$ $V_{SBR1.Eastbound} = 32.00 \cdot yd^3$

$V_{SBR1.Westbound} := Ceil\left(A_{SBR1} \cdot L_{SBR1.Westbound}, yd^3\right)$ $V_{SBR1.Westbound} = 4.00 \cdot yd^3$

$Total_{511.Parapet} := Ceil\left(V_{SBR1.Eastbound} + 2V_{SBR1.Westbound}, yd^3\right)$ $Total_{511.Parapet} = 40.00 \cdot yd^3$

ITEM 511E41010 - CLASS QC1 CONCRETE, PIER ABOVE FOOTING — CY

Column:

$D_{column} := 3.00ft$ *Diameter of Column*

$h_{P1.Column} := 13.79ft$ *Height From Elevations given on Pier Details Sheet*

$h_{P2.Column} := 16.35ft$ *Height From Elevations given on Pier Details Sheet*

$n_{columns} := 2$ *Number of Columns per Pier*

$A_{Column} := \frac{\pi D_{column}^2}{4}$ $A_{Column} = 7.07 \cdot ft^2$

$V_{Pier.1.Column} := h_{P1.Column} \cdot n_{columns} \cdot A_{Column}$ $V_{Pier.1.Column} = 7.22 \cdot yd^3$

$V_{Pier.2.Column} := h_{P2.Column} \cdot n_{columns} \cdot A_{Column}$ $V_{Pier.2.Column} = 8.56 \cdot yd^3$

$V_{Columns} := V_{Pier.1.Column} + V_{Pier.2.Column}$ $V_{Columns} = 15.78 \cdot yd^3$

Pier Cap:

$A_{P1.Seat.1} := 9.38ft^2$ *Plan Area of Pier 1 Seat 1*

$A_{P1.Seat.2} := 25.41ft^2$ *Plan Area of Pier 1 Seat 2*

$A_{P1.Seat.3} := 16.23ft^2$ *Plan Area of Pier 1 Seat 3*

$h_{P1.Cap.Seat.1} := 4.67ft$ *Height of Pier 1 Cap Seat 1*

$h_{P1.Cap.Seat.2} := 5.07ft$ *Height of Pier 1 Cap Seat 2*

$h_{P1.Cap.Seat.3} := 4.77ft$ *Height of Pier 1 Cap Seat 3*

$A_{P2.Seat.1} := 10.01ft^2$ *Plan Area of Pier 2 Seat 1*

$A_{P2.Seat.2} := 26.77ft^2$ *Plan Area of Pier 2 Seat 2*

$A_{P2.Seat.3} := 16.93ft^2$ *Plan Area of Pier 2 Seat 3*

$h_{P2.Cap.Seat.1} := 4.88ft$ *Height of Pier 2 Cap Seat 1*

$h_{P2.Cap.Seat.2} := 5.12ft$ *Height of Pier 2 Cap Seat 2*

$h_{P2.Cap.Seat.3} := 4.81ft$ *Height of Pier 2 Cap Seat 3*

$V_{Pier.1.Cap} := A_{P1.Seat.1} \cdot h_{P1.Cap.Seat.1} + A_{P1.Seat.2} \cdot h_{P1.Cap.Seat.2} + A_{P1.Seat.3} \cdot h_{P1.Cap.Seat.3}$ $V_{Pier.1.Cap} = 9.26 \cdot yd^3$

$V_{Pier.2.Cap} := A_{P2.Seat.1} \cdot h_{P2.Cap.Seat.1} + A_{P2.Seat.2} \cdot h_{P2.Cap.Seat.2} + A_{P2.Seat.3} \cdot h_{P2.Cap.Seat.3}$ $V_{Pier.2.Cap} = 9.90 \cdot yd^3$

$V_{Pier.Cap} := V_{Pier.1.Cap} + V_{Pier.2.Cap}$ $V_{Pier.Cap} = 19.16 \cdot yd^3$

Total Pier Concrete:

$Total_{511.Pier} := Ceil\left(V_{Columns} + V_{Pier.Cap}, yd^3\right)$ $Total_{511.Pier} = 35.00 \cdot yd^3$

ITEM 511E43510 - CLASS QC1 CONCRETE, ABUTMENT INCLUDING FOOTING **CY**

Footing:

$t_{Foot.Max} := 3.25ft$ *Thickness of Abutment Footing (Max Thickness)*

$t_{Foot.Min} := 3.00ft$ *Thickness of Abutment Footing (Min. Thickness)*

$A_{Rear.Foot.Max} := 70.52ft^2$ *Plan Area of Rear Abutment Footing (Portion with Maximum Thickness)*

$A_{Rear.Foot.Min} := 81.40ft^2$ *Plan Area of Rear Abutment Footing (Portion with Minimum Thickness)*

$A_{Fwd.Foot.Max} := 73.78ft^2$ *Plan Area of Fwd. Abutment Footing (Portion with Maximum Thickness)*

$A_{Fwd.Foot.Min} := 90.90ft^2$ *Plan Area of Fwd. Abutment Footing (Portion with Minimum Thickness)*

$V_{Rear.Foot} := A_{Rear.Foot.Max} \cdot t_{Foot.Max} + A_{Rear.Foot.Min} \cdot t_{Foot.Min}$ $V_{Rear.Foot} = 17.53 \cdot yd^3$

$V_{Fwd.Foot} := A_{Fwd.Foot.Max} \cdot t_{Foot.Max} + A_{Fwd.Foot.Min} \cdot t_{Foot.Min}$ $V_{Fwd.Foot} = 18.98 \cdot yd^3$

$V_{Total.Foot} := V_{Rear.Foot} + V_{Fwd.Foot}$ $V_{Total.Foot} = 36.51 \cdot yd^3$

Stem:

$w_{Stem} := 3.75ft$ *Width of Abutment Stem*

$A_{RA.Stem} := 60.21ft^2$ *Elevation Area of Rear Abutment Stem*

$A_{FA.Stem} := 62.52ft^2$ *Elevation Area of Fwd. Abutment Stem*

$V_{Rear.Stem} := A_{RA.Stem} \cdot w_{Stem}$ $V_{Rear.Stem} = 8.36 \cdot yd^3$

$V_{Fwd.Stem} := A_{FA.Stem} \cdot w_{Stem}$ $V_{Fwd.Stem} = 8.68 \cdot yd^3$

$V_{Total.Stem} := V_{Rear.Stem} + V_{Fwd.Stem}$ $V_{Total.Stem} = 17.05 \cdot yd^3$

Wingwalls:

$A_{Rear.Wing} := 81.70ft^2$ *Face Area of Rear Wingwall (Measured from Microstation)*

$A_{Fwd.Wing} := 88.95ft^2$ *Face Area of Fwd. Wingwall (Measured from Microstation)*

$w_{Wing} := 1.50ft$ Width of Wingwall

$V_{Rear.Wing} := A_{Rear.Wing} \cdot w_{Wing}$ $V_{Rear.Wing} = 4.54 \cdot yd^3$

$V_{Fwd.Wing} := A_{Fwd.Wing} \cdot w_{Wing}$ $V_{Fwd.Wing} = 4.94 \cdot yd^3$

$V_{Total.Wing} := V_{Rear.Wing} + V_{Fwd.Wing}$ $V_{Total.Wing} = 9.48 \cdot yd^3$

Total Abument Concrete:

$Total_{511.Abutment} := Ceil\left(V_{Total.Foot} + V_{Total.Stem} + V_{Total.Wing}, yd^3\right)$ $Total_{511.Abutment} = 64.00 \cdot yd^3$

ITEM 511E46510 - CLASS QC1 CONCRETE, FOOTING **CY**

$A_{Pier.Footing} := 52.00ft^2$ *Plan Area of Pier Footing*

$t_{Pier.Footing} := 3.00ft$ *Thickness of Pier Footing*

$n_{Pier.Footing} := 4$ *Number of Pier Footings*

$Total_{511.Footing} := Ceil\left(n_{Pier.Footing} \cdot A_{Pier.Footing} \cdot t_{Pier.Footing}, yd^3\right)$ $Total_{511.Footing} = 24.00 \cdot yd^3$

ITEM 512E10101 - SEALING OF CONCRETE SURFACES (EPOXY-URETHANE), AS PER PLAN **SY**

Abutment Sealing *(Areas Measured from CABUTMENT.dgn Basemap)*

Rear Abutment:

Stem and Cap:

$A_{Rear.Face.Stem} := 97.58\,ft^2$ *Front Face of Cap and Stem Between Ground Line and App.Slab Seat CJ*

Wingwalls:

$A_{Wing.Rear.Side} := 39.50\,ft^2$ *Side Face Area of Rear Wingwall*

$L_{Wing.Rear.Top} := 14.00\,ft$ *Total Distance of Top of Right Rear Wingwall Including Sloped Portion and Vertical Side Length*

$w_{Wing} = 1.50\ ft$ *Width of the Wingwall*

$A_{Wing.Rear.Top} := L_{Wing.Rear.Top} \cdot w_{Wing}$ $A_{Wing.Rear.Top} = 21.00 \cdot ft^2$

$A_{Wing.RA.Seal} := A_{Wing.Rear.Side} + A_{Wing.Rear.Top}$ $A_{Wing.RA.Seal} = 60.50 \cdot ft^2$

Total Rear Abutment:

$A_{Total.Seal.RA} := A_{Rear.Face.Stem} + A_{Wing.RA.Seal}$ $A_{Total.Seal.RA} = 158.08 \cdot ft^2$

Forward Abutment:

Stem and Cap:

$A_{Fwd.Face.Stem} := 106.48\,ft^2$ *Front Face of Cap and Stem Between Ground Line and App. Slab Seat CJ*

Wingwalls:

$A_{Wing.Fwd.Side} := 39.00\,ft^2$ *Front Face Area of Left Fwd Wingwall*

$L_{Wing.Fwd.Top} := 15.00\,ft$ *Total Distance of Top of Left Fwd Wingwall Including Sloped Portion and Vertical Side Length*

$w_{Wing} = 1.50\ ft$ *Width of the Wingwall*

$A_{Wing.Fwd.Top} := L_{Wing.Fwd.Top} \cdot w_{Wing}$ $A_{Wing.Fwd.Top} = 22.50 \cdot ft^2$

$A_{Wing.FA.Seal} := A_{Wing.Fwd.Side} + A_{Wing.Fwd.Top}$ $A_{Wing.FA.Seal} = 61.50 \cdot ft^2$

Total Fwd Abutment:

$A_{Total.Seal.FA} := A_{Fwd.Face.Stem} + A_{Wing.FA.Seal}$ $A_{Total.Seal.FA} = 167.98 \cdot ft^2$

Total Abutment Sealing:

$Total_{Abut.Seal} := Ceil\left(A_{Total.Seal.RA} + A_{Total.Seal.FA}, yd^2\right)$ $Total_{Abut.Seal} = 37.00 \cdot yd^2$

Pier Sealing *(Measured from Microstation)*

$P_{Column} := \pi D_{column}$ $P_{Column} = 9.42\,ft$ *Perimeter of Column*

$n_{columns} = 2.00$ *Number of Columns per Individual Pier*

$P_{P1.Cap.Seat.1} := 3.79ft$	*Perimeter of Pier 1 Beam Seat 1*	$h_{P1.Cap.Seat.1} = 4.67\,ft$	*Height of Pier 1 Cap Seat 1*
$P_{P1.Cap.Seat.2} := 8.47ft$	*Perimeter of Pier 1 Beam Seat 2*	$h_{P1.Cap.Seat.2} = 5.07\,ft$	*Height of Pier 1 Cap Seat 2*
$P_{P1.Cap.Seat.3} := 6.59ft$	*Perimeter of Pier 1 Beam Seat 3*	$h_{P1.Cap.Seat.3} = 4.77\,ft$	*Height of Pier 1 Cap Seat 3*
$P_{P2.Cap.Seat.1} := 4.00ft$	*Perimeter of Pier 2 Beam Seat 1*	$h_{P2.Cap.Seat.1} = 4.88\,ft$	*Height of Pier 2 Cap Seat 1*
$P_{P2.Cap.Seat.2} := 8.92ft$	*Perimeter of Pier 2 Beam Seat 2*	$h_{P2.Cap.Seat.2} = 5.12\,ft$	*Height of Pier 2 Cap Seat 2*
$P_{P2.Cap.Seat.3} := 6.82ft$	*Perimeter of Pier 2 Beam Seat 3*	$h_{P2.Cap.Seat.3} = 4.81\,ft$	*Height of Pier 2 Cap Seat 3*

$A_{P1.Cap.Bottom.1} := 18.46ft^2$ *Plan Area of Pier 1 Bottom of Cap b/w Columns*

$A_{P1.Cap.Bottom.2} := 18.46ft^2$ *Plan Area of Pier 1 Bottom of Cap b/w Columns*

$A_{P2.Cap.Bottom.1} := 19.77ft^2$ *Plan Area of Pier 2 Bottom of Cap b/w Columns*

$A_{P2.Cap.Bottom.2} := 19.80ft^2$ *Plan Area of Pier 2 Bottom of Cap b/w Columns*

$h_{P1.Column.1} := 11.83ft$ *Height of Pier 1 Column 1 above Ground Line*

$h_{P1.Column.2} := 11.49ft$ *Height of Pier 1 Column 2 above Ground Line*

$h_{P2.Column.1} := 14.25ft$ *Height of Pier 1 Column 1 above Ground Line*

$h_{P2.Column.2} := 13.91ft$ *Height of Pier 2 Column 2 above Ground Line*

$A_{Pier.1.Cap.Seal} := 2 \cdot P_{P1.Cap.Seat.1} \cdot h_{P1.Cap.Seat.1} + 2P_{P1.Cap.Seat.2} \cdot h_{P1.Cap.Seat.2} \cdots + 2P_{P1.Cap.Seat.3} \cdot h_{P1.Cap.Seat.3} + A_{P1.Cap.Bottom.1} + A_{P1.Cap.Bottom.2}$ $A_{Pier.1.Cap.Seal} = 221.07 \cdot ft^2$

$A_{Pier.2.Cap.Seal} := 2P_{P2.Cap.Seat.1} \cdot h_{P2.Cap.Seat.1} + 2P_{P2.Cap.Seat.2} \cdot h_{P2.Cap.Seat.2} \cdots + 2P_{P2.Cap.Seat.3} \cdot h_{P2.Cap.Seat.3} + A_{P2.Cap.Bottom.1} + A_{P2.Cap.Bottom.2}$ $A_{Pier.2.Cap.Seal} = 235.56 \cdot ft^2$

$A_{Pier.1.Column.Seal} := P_{Column} \cdot (h_{P1.Column.1} + h_{P1.Column.2})$ $A_{Pier.1.Column.Seal} = 219.79 \cdot ft^2$

$A_{Pier.2.Column.Seal} := P_{Column} \cdot (h_{P2.Column.1} + h_{P2.Column.2})$ $A_{Pier.2.Column.Seal} = 265.40 \cdot ft^2$

$A_{Pier.1.Seal} := A_{Pier.1.Cap.Seal} + A_{Pier.1.Column.Seal}$ $A_{Pier.1.Seal} = 440.86 \cdot ft^2$

$A_{Pier.2.Seal} := A_{Pier.2.Cap.Seal} + A_{Pier.2.Column.Seal}$ $A_{Pier.2.Seal} = 500.96 \cdot ft^2$

$Total_{Pier.Seal} := Ceil(A_{Pier.1.Seal} + A_{Pier.2.Seal}, yd^2)$ $Total_{Pier.Seal} = 105.00 \cdot yd^2$

Superstructure Sealing *(Measured from Microstation)*

$P_{Super.Seal} := 9.40ft$ *Minimum Perimeter of Sealing around Barrier and Overhang*

$P_{SBR.Barrier} := 7.83ft$ *Perimeter of Sealing around Barrier*

$L_{Appr.Slab} := 25.00ft$ *Length of Approach Slab Barrier*

$L_{Bridge.Barrier} := 159.72ft$ *Length of Bridge Barrier*

$Total_{Super.Seal.Eastbound} := Ceil\left(P_{Super.Seal} \cdot L_{Bridge.Barrier} + P_{SBR.Barrier} \cdot 2 \cdot L_{Appr.Slab}, yd^2\right)$ $Total_{Super.Seal.Eastbound} = 211.00 \cdot yd^2$

$Total_{Super.Seal.Westbound} := Ceil\left(P_{SBR.Barrier} \cdot 2 \cdot L_{Appr.Slab}, yd^2\right)$ $Total_{Super.Seal.Westbound} = 44.00 \cdot yd^2$

Total Epoxy Sealing

$$Total_{512.Epoxy} := Ceil\left(\begin{matrix} Total_{Abut.Seal} + Total_{Pier.Seal} \ldots \\ + Total_{Super.Seal.Eastbound} + Total_{Super.Seal.Westbound} \end{matrix}, yd^2\right)$$

$Total_{512.Epoxy} = 397.00 \cdot yd^2$

ITEM 512E33000 - TYPE 2 WATERPROOFING **SY**

$n_{Cap.Joints} := 2$ *Number of Abutment Cap Joints*

$w_{Type.2} := 3.00ft$ *Width of Type 2 Waterprooping*

$h_{Type.2.Cap} := 4.75ft$ *Height of Stage Const.Joint in Abutment Cap*

$h_{Type.2.Stem} := 3.25ft$ *Height of Stage Const.Joint in Abutment Stem*

$Total_{512.Type.2} := Ceil\left[n_{Abuts} \cdot w_{Type.2} \cdot \left(n_{Cap.Joints} \cdot h_{Type.2.Cap} + h_{Type.2.Stem}\right), yd^2\right]$ $Total_{512.Type.2} = 9.00 \cdot yd^2$

ITEM 513E10260 - STRUCTURAL STEEL MEMBERS, LEVEL 3 **POUND**

Beams:

$wt_{Beam.Seg.1} := 150\,\frac{lbf}{ft}$ *Weight of Beam in Segment 1*

$wt_{Beam.Seg.2} := 182\,\frac{lbf}{ft}$ *Weight of Beam in Segment 2*

$wt_{Beam.Seg.3} := 160\,\frac{lbf}{ft}$ *Weight of Beam in Segment 3*

$L_{B1.Seg.1} := 21.6667\,ft$ *Length of Beam B1 Segment 1*

$L_{B1.Seg.2} := 97.6042\,ft$ *Length of Beam B1 Segment 2*

$L_{B1.Seg.3} := 35.6146\,ft$ *Length of Beam B1 Segment 3*

$L_{B2.Seg.1} := 21.6667\,ft$ *Length of Beam B2 Segment 1*

$L_{B2.Seg.2} := 97.6667\,ft$ *Length of Beam B2 Segment 2*

$L_{B2.Seg.3} := 35.6458\,ft$ *Length of Beam B2 Segment 3*

$wt_{Segment.1} := wt_{Beam.Seg.1} \cdot (L_{B1.Seg.1} + L_{B2.Seg.1})$ $wt_{Segment.1} = 6500.01\,lbf$

$wt_{Segment.2} := wt_{Beam.Seg.2} \cdot (L_{B1.Seg.2} + L_{B2.Seg.2})$ $wt_{Segment.2} = 35539.30\,lbf$

$wt_{Segment.3} := wt_{Beam.Seg.3} \cdot (L_{B1.Seg.3} + L_{B2.Seg.3})$ $wt_{Segment.3} = 11401.66\,lbf$

$wt_{Total.Beams} := wt_{Segment.1} + wt_{Segment.2} + wt_{Segment.3}$ $wt_{Total.Beams} = 53440.98\,lbf$

Splice:

Web:

$w_{web.PL} := 24in$

$h_{web.PL} := 31in$

$t_{web.PL} := \frac{9}{16}in$

$V_{Web.PL} := w_{web.PL} \cdot h_{web.PL} \cdot t_{web.PL}$ $V_{Web.PL} = 0.2422 \cdot ft^3$

Inside Flange:

$w_{Inner.PL} := 4.50in$

$L_{Inner.PL} := 3.1667ft$

$t_{Inner.PL} := \frac{5}{8}in$

$V_{Inner.PL} := w_{Inner.PL} \cdot L_{Inner.PL} \cdot t_{Inner.PL}$ $V_{Inner.PL} = 0.0618 \cdot ft^3$

Outer Flange:

$w_{Outer.PL} := 12.00in$

$t_{Outer.PL} := \frac{1}{2}in$

$L_{Outer.PL} := 3.1667ft$

$V_{Outer.PL} := w_{Outer.PL} \cdot t_{Outer.PL} \cdot L_{Outer.PL}$ $V_{Outer.PL} = 0.1319 \cdot ft^3$

Filler Plate:

$w_{Filler.PL} := 11.875in$

$L_{Filler.PL} := 1.5833ft$

$t_{Filler.PL} := \frac{1}{4}in$

$V_{Filler.PL} := w_{Filler.PL} \cdot L_{Filler.PL} \cdot t_{Filler.PL}$ $V_{Filler.PL} = 0.0326 \cdot ft^3$

Web Filler Plate:

$w_{Web.Filler.PL} := 12.00in$

$L_{Web.Filler.PL} := 31in$

$t_{Web.Filler.PL} := \frac{1}{16}in$

$V_{Web.Filler.PL} := w_{Web.Filler.PL} \cdot L_{Web.Filler.PL} \cdot t_{Web.Filler.PL}$ $V_{Web.Filler.PL} = 0.0135 \cdot ft^3$

Bolts:

$n_{Bolts.Web} := 54$

$n_{Bolts.Flange} := 20$

$wt_{Bolt.Flange} := 2.5lbf$

$wt_{Bolt.Web} := 2.2lbf$

$t_{Flange.W36x182} := 1.18in$

$t_{Flange.W36x160} := 1.02in$

$t_{Flange.W36x150} := 0.940in$

$t_{Web.W36x182} := 0.725in$

$t_{Web.W36x160} := 0.650in$

$t_{Web.W36x150} := 0.625in$

$A_{Bolt.Hole} := 1.107in^2$

$wt_{Bolt.Reduction.Web.1} := 0.5 \cdot n_{Bolts.Web} \cdot A_{Bolt.Hole} \cdot \gamma_{steel} \cdot \left[\left(2 \cdot t_{web.PL} + t_{Web.W36x182} \right) + \left(2 \cdot t_{web.PL} + t_{Web.Filler.PL} + t_{Web.W36x160} \right) \right]$

$wt_{Bolt.Reduction.Web.1} = 31.25 \cdot lbf$

$wt_{Bolt.Reduction.Web.2} := 0.5 \cdot n_{Bolts.Web} \cdot A_{Bolt.Hole} \cdot \gamma_{steel} \cdot \left[\left(2 \cdot t_{web.PL} + t_{Web.W36x182} \right) + \left(2 \cdot t_{web.PL} + t_{Web.Filler.PL} + t_{Web.W36x150} \right) \right]$

$wt_{Bolt.Reduction.Web.2} = 31.04 \cdot lbf$

$wt_{Bolt.Reduction.Flange.1} := n_{Bolts.Flange} \cdot A_{Bolt.Hole} \cdot \gamma_{steel} \cdot \left(\begin{matrix} t_{Flange.W36x182} + t_{Outer.PL} + t_{Inner.PL} \cdots \\ + t_{Flange.W36x160} + t_{Filler.PL} + t_{Outer.PL} + t_{Inner.PL} \end{matrix} \right)$

$wt_{Bolt.Reduction.Flange.1} = 29.51\ lbf$

$wt_{Bolt.Reduction.Flange.2} := n_{Bolts.Flange} \cdot A_{Bolt.Hole} \cdot \gamma_{steel} \cdot \left(\begin{matrix} t_{Flange.W36x182} + t_{Outer.PL} + t_{Inner.PL} \cdots \\ + t_{Flange.W36x150} + t_{Filler.PL} + t_{Outer.PL} + t_{Inner.PL} \end{matrix} \right)$

$wt_{Bolt.Reduction.Flange.2} = 29.00\ lbf$

$wt_{Bolt.Splice.1} := n_{Bolts.Web} \cdot wt_{Bolt.Web} + 2 \cdot n_{Bolts.Flange} \cdot wt_{Bolt.Flange} - wt_{Bolt.Reduction.Web.1} - wt_{Bolt.Reduction.Flange.1}$

$wt_{Bolt.Splice.1} = 158.04\ lbf$

$wt_{Bolt.Splice.2} := n_{Bolts.Web} \cdot wt_{Bolt.Web} + 2 \cdot n_{Bolts.Flange} \cdot wt_{Bolt.Flange} - wt_{Bolt.Reduction.Web.2} - wt_{Bolt.Reduction.Flange.2}$

$wt_{Bolt.Splice.2} = 158.75\ lbf$

$wt_{Splice} := 2 \cdot \gamma_{steel} \cdot \left(2 \cdot V_{Web.PL} + V_{Web.Filler.PL} + 4 \cdot V_{Inner.PL} + 2 V_{Outer.PL} + 2 \cdot V_{Filler.PL} \right) + wt_{Bolt.Splice.1} + wt_{Bolt.Splice.2}$

$n_{Beams} := 2$

$wt_{Total.Splice} := n_{Beams} \cdot wt_{Splice}$ $\quad wt_{Total.Splice} = 2739.42\ lbf$

Crossframes:

Filler Plate:

$w_{Fill.PL} := 6in$ *Width of Fill Plate*

$L_{Fill.PL} := 2.6667ft$ *Length of Fill Plate*

$t_{Fill.PL} := 0.375in$ *Thickness of Fill Plate*

$wt_{Fill.PL} := \gamma_{steel} \cdot w_{Fill.PL} \cdot L_{Fill.PL} \cdot t_{Fill.PL}$ $\quad wt_{Fill.PL} = 20.42\ lbf$

Stiffner Plate:

$A_{Stiff.PL} := 1.78ft^2$ *Width of Stiffner Plate*

$t_{Stiff.PL} := 0.375in$ *Thickness of Stiffner Plate*

$wt_{Stiff.PL} := \gamma_{steel} \cdot A_{Stiff.PL} \cdot t_{Stiff.PL}$ $\quad wt_{Stiff.PL} = 27.26\ lbf$

L Angle Bar

$wt_{L.Bar} := 16.20 \frac{lbf}{ft}$ *Weight of L5x5x1/2"*

$L_{Bot.Bar} := 8.25ft$ *Length of Bot. Bar in Crossframe*

$L_{Cross.Bar} := 8.50ft$ *Length of Crossed Bar in Crossframe*

$t_{Angle} := 0.50in$ *Thickness of Angle*

$wt_{Bot.L.Bar} := wt_{L.Bar} \cdot L_{Bot.Bar}$ $wt_{Bot.L.Bar} = 133.65\,lbf$

$wt_{Cross.L.Bar} := wt_{L.Bar} \cdot L_{Cross.Bar}$ $wt_{Cross.L.Bar} = 137.70\,lbf$

Bolts

$n_{Bolts.Stiff} := 6.00$

$wt_{Bolt} := 1.2lbf$

$A_{Bolt.Hole.Angle} := 0.518in^2$ *Area of Bolt Hole thru Gusset Plates*

$A_{Bolt.Hole.Stiffner} := 0.371in^2$ *Area of Bolt Hole thru Stiffener Plates*

$V_{Bolt.Reduction.Stiffener} := n_{Bolts.Stiff} \cdot A_{Bolt.Hole.Stiffner} \cdot t_{Stiff.PL}$ $V_{Bolt.Reduction.Stiffener} = 0.83 \cdot in^3$

$V_{Bolt.Reduction.Angle} := n_{Bolts.Stiff} \cdot A_{Bolt.Hole.Angle} \cdot t_{Angle}$ $V_{Bolt.Reduction.Angle} = 1.55 \cdot in^3$

$wt_{Bolt.Reduction.Crossframe} := \gamma_{steel} \cdot \left(V_{Bolt.Reduction.Angle} + V_{Bolt.Reduction.Stiffener}\right)$ $wt_{Bolt.Reduction.Crossframe} = 0.68\,lbf$

$wt_{Bolt.Crossframe} := wt_{Bolt} \cdot n_{Bolts.Stiff}$ $wt_{Bolt.Crossframe} = 7.20\,lbf$

Crossframe

$wt_{crossframe} := wt_{Fill.PL} + 2 \cdot wt_{Stiff.PL} + 2 \cdot wt_{Cross.L.Bar} + wt_{Bot.L.Bar} \cdots$
$+ wt_{Bolt.Crossframe} - wt_{Bolt.Reduction.Crossframe}$

$wt_{crossframe} = 490.50\,lbf$

$n_{Crossframes} := 24$

$wt_{Total.Crossframe} := n_{Crossframes} \cdot wt_{crossframe}$ $wt_{Total.Crossframe} = 11772.05\,lbf$

Total:

$Total_{513.Struct.Steel} := Ceil\left[\left(wt_{Total.Beams} + wt_{Total.Crossframe} + wt_{Total.Splice}\right), lbf\right]$ $Total_{513.Struct.Steel} = 67953.00\,lbf$

ITEM 513E20000 - WELDED STUD SHEAR CONNECTORS **EACH**

$n_{Studs} := 747$ *Number of Shear Studs Per Beam (Calculated From Spacing Given on Framing Plan Sheet)*

$n_{Beams} = 2.00$

$Total_{513.Shear.Stud} := n_{Studs} \cdot n_{Beams}$ $Total_{513.Shear.Stud} = 1494.00$

ITEM 514E00060 - FIELD PAINTING STRUCTURAL STEEL, INTERMEDIATE COAT **SF**

Beam:

$P_{Beam} := 8.62\,ft$ *Perimeter of Beam*

$L_{Beam.B1} := 155.885\,ft$ *Length of Beam B1*

$L_{Beam.B2} := 156.00\,ft$ *Length of Beam B2*

$A_{Beam.Paint} := P_{Beam} \cdot (L_{Beam.B1} + L_{Beam.B2})$ $A_{Beam.Paint} = 2688.45 \cdot ft^2$

Crossframe:

$w_{xframe.angle} := 5\,in$ *Width of Crossframe*

$L_{Bot.Bar} = 8.25\,ft$ *Length of Bot. Bar in Crossframe*

$L_{Cross.Bar} = 8.50\,ft$ *Length of Crossed Bar in Crossframe*

$A_{Stiff.PL} = 1.78 \cdot ft^2$ *Area of Stiffner Plate*

$t_{Stiff.PL} = 0.38 \cdot in$ *Thickness of Stiffner Plate*

$A_{Stiff.PL.Paint} := 2 \cdot A_{Stiff.PL}$ $A_{Stiff.PL.Paint} = 3.56 \cdot ft^2$

$A_{Bot.Bar} := 4 \cdot L_{Bot.Bar} \cdot w_{xframe.angle}$ $A_{Bot.Bar} = 13.75 \cdot ft^2$

$A_{Cross.Bar} := 4 \cdot L_{Cross.Bar} \cdot w_{xframe.angle}$ $A_{Cross.Bar} = 14.17 \cdot ft^2$

$A_{Crossframe.Paint} := 2 \cdot A_{Stiff.PL.Paint} + A_{Bot.Bar} + 2 \cdot A_{Cross.Bar}$ $A_{Crossframe.Paint} = 49.20 \cdot ft^2$

$n_{Crossframes} = 24.00$ *Number of Crossframes*

Total Paint:

$Total_{514.Intermediate.Paint} := Ceil(A_{Beam.Paint} + n_{Crossframes} \cdot A_{Crossframe.Paint}, ft^2)$ $Total_{514.Intermediate.Paint} = 3870.00 \cdot ft^2$

ITEM 514E00066 - FIELD PAINTING STRUCTURAL STEEL, FINISH COAT **SF**

$Total_{514.Finish.Paint} := Total_{514.Intermediate.Paint}$ $Total_{514.Finish.Paint} = 3870.00 \cdot ft^2$

ITEM 516E13600 - 1" PREFORMED EXPANSION JOINT FILLER — SF

$A_{SBR1} = 4.08 \cdot ft^2$

$A_{1in.PEJF.Eastbound} := Ceil\left(2 \cdot A_{SBR1}, ft^2\right)$ $A_{1in.PEJF.Eastbound} = 9.00 \cdot ft^2$

$A_{1in.PEJF.Westbound} := Ceil\left(2A_{SBR1}, ft^2\right)$ $A_{1in.PEJF.Westbound} = 9.00 \cdot ft^2$

$Total_{516.PEJF.1in} := Ceil\left(A_{1in.PEJF.Eastbound} + A_{1in.PEJF.Westbound}, ft^2\right)$ $Total_{516.PEJF.1in} = 18.00 \cdot ft^2$

ITEM 516E13900 - 2" PREFORMED EXPANSION JOINT FILLER — SF

Cap Side:

$w_{Cap.Edge.RA} := 3.77ft$ *Width of Cap at Rear Abut Cap Edge*

$w_{Cap.Edge.FA} := 3.78ft$ *Width of Cap at Cap Edge*

$h_{Cap.Edge.RA} := 4.86ft$ *Height of Cap at Rear Abut Cap Edge*

$h_{Cap.Edge.FA} := 4.82ft$ *Height of Cap at Fwd Abut Cap Edge*

$A_{RA.Cap.Side} := w_{Cap.Edge.RA} \cdot h_{Cap.Edge.RA}$ $A_{RA.Cap.Side} = 18.32 \cdot ft^2$

$A_{FA.Cap.Side} := w_{Cap.Edge.FA} \cdot h_{Cap.Edge.FA}$ $A_{FA.Cap.Side} = 18.22 \cdot ft^2$

$A_{Total.Cap.Side} := A_{RA.Cap.Side} + A_{FA.Cap.Side}$ $A_{Total.Cap.Side} = 36.54 \cdot ft^2$

Wingwalls:

$w_{wing.fill} := 15in$ *Width of Wingwall Joint Filler (Thickness of Approach Slab)*

$L_{RA.Wing} := 10.21ft$ *Length of Rear Abutment Wingwall Past Back of Cap*

$L_{FA.Wing} := 11.42ft$ *Length of Fwd. Abutment Wingwall Past Back of Cap*

$A_{RA.Wing.Fill} := w_{wing.fill} \cdot \left(L_{RA.Wing}\right)$ $A_{RA.Wing.Fill} = 12.76 \cdot ft^2$

$A_{FA.Wing.Fill} := w_{wing.fill} \cdot \left(L_{FA.Wing}\right)$ $A_{FA.Wing.Fill} = 14.28 \cdot ft^2$

$A_{Total.Wing.Fill} := A_{RA.Wing.Fill} + A_{FA.Wing.Fill}$ $A_{Total.Wing.Fill} = 27.04 \cdot ft^2$

Total 2" Joint Filler:

$Total_{516.PEJF.2in} := Ceil\left(A_{Total.Cap.Side} + A_{Total.Wing.Fill}, ft^2\right)$ $Total_{516.PEJF.2in} = 64.00 \cdot ft^2$

ITEM 516E14020 - SEMI-INTEGRAL ABUTMENT EXPANSION JOINT SEAL — FT

$L_{RA.Horiz.strip} := 19.71\,ft$ Length of Rear Abut Horizontal Joint Seal

$L_{RA.Vert.Strip} := 4.46\,ft$ Length of Rear Abut Vertical Joint Seal

$L_{FA.Horiz.strip} := 23.09\,ft$ Length of Fwd Abut Horizontal Joint Seal

$L_{FA.Vert.Strip} := 4.57\,ft$ Length of Fwd Abut Vertical Joint Seal

$Total_{516.Exp.Joint.Seal} := Ceil\left[\left(L_{RA.Horiz.strip} + L_{RA.Vert.Strip} + L_{FA.Horiz.strip} + L_{FA.Vert.Strip}\right), ft\right]$ $Total_{516.Exp.Joint.Seal} = 52.00\ ft$

ITEM 516E44200 - ELASTOMERIC BEARING WITH INTERNAL LAMINATES (10"x14"x3.1282") AND LOAD PLATE (11"x15"x1.50") (NEOPRENE) — EACH

$n_{Beams} = 2.00$ *Number of Beams*

$n_{Abuts} = 2.00$ *Number of Abutments*

$Total_{516.Abut.Bearing} := n_{Beams} \cdot n_{Abuts}$ $Total_{516.Abut.Bearing} = 4.00$

ITEM 516E44100 - ELASTOMERIC BEARING WITH INTERNAL LAMINATES (13"x15"x2.6535") AND LOAD PLATE (14"x16"xVARIES") (NEOPRENE) — EACH

$n_{Beams} = 2.00$ *Number of Beams*

$n_{Piers} = 2.00$ *Number of Piers*

$Total_{516.Pier.Bearing} := n_{Beams} \cdot n_{Piers}$ $Total_{516.Pier.Bearing} = 4.00$

ITEM 518E21200 - POROUS BACKFILL WITH GEOTEXTILE FABRIC — CY

Abutment Cap:

$h_{Backfill.Edge.RA} := 6.32\,ft$ *Height of Backfill at Edge of Rear Abutment Cap*

$h_{Backfill.Crown.RA} := 6.75\,ft$ *Height of Backfill at Crown of Rear Abutment*

$$h_{Avg.Backfill.RA} := \frac{h_{Backfill.Edge.RA} + h_{Backfill.Crown.RA}}{2} \qquad h_{Avg.Backfill.RA} = 6.54\,ft$$

$h_{Backfill.Edge.FA} := 6.23\,ft$ *Height of Backfill at Edge of Fwd. Abutment Cap*

$h_{Backfill.Crown.FA} := 6.67\,ft$ *Height of Backfill at Crown of Fwd. Abutment*

$$h_{Avg.Backfill.FA} := \frac{h_{Backfill.Edge.FA} + h_{Backfill.Crown.FA}}{2} \qquad h_{Avg.Backfill.FA} = 6.45\,ft$$

$A_{Backfill.RA} := 51.17\,ft^2$ *Plan Area of Backfill for Rear Abutment*

$A_{Backfill.FA} := 54.48\,ft^2$ *Plan Area of Backfill for Fwd Abutment*

$V_{RA.Backfill} := A_{Backfill.RA} \cdot h_{Avg.Backfill.RA} \qquad V_{RA.Backfill} = 12.39 \cdot yd^3$

$V_{FA.Backfill} := A_{Backfill.FA} \cdot h_{Avg.Backfill.FA} \qquad V_{FA.Backfill} = 13.01 \cdot yd^3$

Total Backfill:

$Total_{518.Backfill} := Ceil\left(V_{RA.Backfill} + V_{FA.Backfill}, yd^3\right)$ $\qquad Total_{518.Backfill} = 26.00 \cdot yd^3$

ITEM 518E40000 - 6" PERFORATED CORRUGATED PLASTIC PIPE — FT

Lengths Measured from Microstation

$L_{RA.Perf.Pipe} := 26.50\,ft$ *Length of Rear Abutment Perforated Pipe*

$L_{FA.Perf.Pipe} := 30.00\,ft$ *Length of Fwd. Abutment Perforated Pipe*

$Total_{518.Perf.Pipe} := Ceil\left(L_{RA.Perf.Pipe} + L_{FA.Perf.Pipe}, ft\right)$ $\qquad Total_{518.Perf.Pipe} = 57.00\,ft$

ITEM 518E40010 - 6" NON-PERFORATED CORRUGATED PLASTIC PIPE, INCLUDING SPECIALS — FT

$L_{RA.Non.Perf} := 15.00\,ft$ *Approximation Based on Profile View and Plan Views*

$L_{FA.Non.Perf} := 16.00\,ft$ *Approximation Based on Profile View and Plan Views*

$Total_{518.Non.Perf.Pipe} := Ceil\left(L_{RA.Non.Perf} + L_{FA.Non.Perf}, ft\right)$ $\qquad Total_{518.Non.Perf.Pipe} = 31.00\,ft$

ITEM 526E25011 - REINFORCED CONCRETE APPROACH SLAB WITH QC/QA (T=15"), AS PER PLAN **SY**

Measured from Microstation

$A_{Rear.Appr.Slab} := 770.82ft^2$ *Area of Rear Approach Slab*

$A_{Fwd.Appr.Slab} := 853.44ft^2$ *Area of Fwd Approach Slab*

$Total_{526.Appr.Slab} := Ceil\left(A_{Rear.Appr.Slab} + A_{Fwd.Appr.Slab}, yd^2\right)$ $Total_{526.Appr.Slab} = 181.00 \cdot yd^2$

ITEM 601E21000 - CONCRETE SLOPE PROTECTION **SY**

$A_{RA.RCP} := 676.8276ft^2$ *Plan Area of RCP at Rear Abutment from Profile View*

$A_{FA.RCP} := 978.8021ft^2$ *Plan Area of RCP at Fwd. Abutment from Profile View*

$Adjustment := \frac{\sqrt{1^2 + 2^2}}{2}$ $Adjustment = 1.12$

$V_{RA.RCP} := Adjustment \cdot A_{RA.RCP}$ $V_{RA.RCP} = 84.08 \cdot yd^2$

$V_{FA.RCP} := Adjustment \cdot A_{FA.RCP}$ $V_{FA.RCP} = 121.59 \cdot yd^2$

$Total_{601.RCP} := Ceil\left(V_{RA.RCP} + V_{FA.RCP}, yd^2\right)$ $Total_{601.RCP} = 206.00 \cdot yd^2$

ITEM 848E10001 - MICRO-SILICA MODIFIED CONCRETE OVERLAY USING HYDRODEMOLITION (2 1/2" TO 5 1/2"), AS PER PLAN **CY**

$V_{Overlay.bridge} := 97.76yd^3$ *Volume of Overlay (Bridge)*

$V_{Overlay.approaches} := 42.79yd^3$ *Volume of Overlay (Approach Slabs)*

$V_{Removal} := 21.13yd^3$ *Volume of removal for Overlay (0.5" removal on existing surface only)*

$Total_{848.Overlay} := Ceil\left(V_{Overlay.bridge} + V_{Overlay.approaches} + V_{Removal}, yd^3\right)$ $Total_{848.Overlay} = 162.00 \cdot yd^3$

ITEM 848E20001 - SURFACE PREPERATION USING HYDRODEMOLITION, AS PER PLAN **SY**

$A_{Stage.1.Overlay} := 5290.51ft^2$ *Area of Overlay included in Stage 1 Construction (including Approach Slabs)*

$A_{Stage.2.Overlay} := 8134.83ft^2$ *Area of Overlay included in Stage 2 Constrution (including Approach Slabs)*

$Total_{848.Hydrodemo} := Ceil\left(A_{Stage.1.Overlay} + A_{Stage.2.Overlay}, yd^2\right)$ $Total_{848.Hydrodemo} = 1492.00 \cdot yd^2$

ITEM 848E50100 - TEST SLAB **LUMP**

From ODOT Bid Histories Excel

$Total_{848.Test.Slab} := 1200dollars$

SUMMARY

$Total_{202.Struct.Removal} = 30000.00 \cdot dollars$

$Total_{202.Appr.Removal} = 88.00 \cdot yd^2$

$Total_{503.Excavation} = 186.00 \cdot yd^3$

$Total_{505.Mobilization} = 10000.00 \cdot dollars$

$Total_{507.Piles.Furnish} = 1340.00\ ft$

$Total_{507.Piles.Driven} = 1180.00\ ft$

$Total_{509.Epoxy.Steel} = 66101.00\ lbf$

$Total_{509.Replacement.Steel} = 100.00\ lbf$

$Total_{510.Dowels} = 74.00$

$Total_{511.Deck} = 121.00 \cdot yd^3$

$Total_{511.Parapet} = 40.00 \cdot yd^3$

$Total_{511.Pier} = 35.00 \cdot yd^3$

$Total_{511.Abutment} = 64.00 \cdot yd^3$

$Total_{511.Footing} = 24.00 \cdot yd^3$

$Total_{512.Epoxy} = 397.00 \cdot yd^2$

$Total_{512.Type.2} = 9.00 \cdot yd^2$

$Total_{513.Struct.Steel} = 67953.00\ lbf$

$Total_{513.Shear.Stud} = 1494.00$

$Total_{514.Intermediate.Paint} = 3870.00 \cdot ft^2$

$Total_{514.Finish.Paint} = 3870.00 \cdot ft^2$

$Total_{516.PEJF.1in} = 18.00 \cdot ft^2$

$Total_{516.PEJF.2in} = 64.00 \cdot ft^2$

$Total_{516.Exp.Joint.Seal} = 52.00\ ft$

$Total_{516.Pier.Bearing} = 4.00$

$Total_{516.Abut.Bearing} = 4.00$

$Total_{518.Backfill} = 26.00 \cdot yd^3$

$Total_{518.Perf.Pipe} = 57.00\ ft$

$Total_{518.Non.Perf.Pipe} = 31.00\ ft$

$Total_{526.Appr.Slab} = 181.00 \cdot yd^2$

$Total_{601.RCP} = 206.00 \cdot yd^2$

$Total_{848.Overlay} = 486.00\ ft \cdot yd^2$

$Total_{848.Hydrodemo} = 1492.00 \cdot yd^2$

$Total_{848.Test.Slab} = 1200.00 \cdot dollars$