

SFN 3109152 - Quantities

Designer: RJB

Date: 8 / 12 / 2025

Checker:

Date:

Inputs: Yellow

Reference From CAD other Calcs: Purple

Assumptions: Blue

Iterative: Orange

Check: Green

Custom Calcs

$$\div (_{denom}) := \frac{1}{_{denom}}$$

$$plf := lbf \div (ft) = 1.00 \text{ plf} \quad pcf := lbf \div (ft^3) = 1.00 \text{ pcf}$$

$$klf := kip \div (ft) = 1.00 \text{ klf} \quad kcf := kip \div (ft^3) = 1.00 \text{ kcf}$$

202E11003 - PORTIONS OF STRUCTURE REMOVED, OVER 20 FOOT SPAN, AS PER PLAN

$$Quant := Lump_Sum$$

503E11100 - COFFERDAMS AND EXCAVATION BRACING

$$Quant := Lump_Sum$$

503E21100 - UNCLASSIFIED EXCAVATION

$$Excav := Lump_Sum$$

505E11100 - PILE DRIVING EQUIPMENT MOBILIZATION

$$Quant := Lump_Sum$$

507E00501 - 12" CAST-IN-PLACE REINFORCED CONCRETE PILES, DRIVEN, AS PER PLAN

$$Pile_Length := 70 \text{ ft}$$

$$No_Piles := 6$$

$$Driven := No_Piles \cdot Pile_Length = 420 \text{ ft}$$

507E00550 - 12" CAST-IN-PLACE REINFORCED CONCRETE PILES, FURNISHED

$$\text{Extra_Furnish_Length} := 5 \text{ ft}$$

ODOT BDM 305.3.5.2 furnish is order length which includes 5' per pile

$$\text{Furnish} := \text{No_Piles} \cdot (\text{Pile_Length} + \text{Extra_Furnish_Length}) = 450 \text{ ft}$$

509E26000 - GALVANIZED STEEL REINFORCEMENT

$$\text{Rebar_Abut} := 3273$$

$$\text{Rebar_Sup} := 351 + 2303 + 1830 = 4484$$

511E43510 - CLASS QC1 CONCRETE, ABUTMENT INCLUDING FOOTING

$$\text{Rear_Abut_Width} := 11 \text{ ft}$$

Does not include Wing Walls

$$\text{Rear_Foot_Depth} := 3 \text{ ft}$$

$$\text{Rear_Foot_Length} := 6.5 \text{ ft}$$

Along Bridge Length

$$\text{Rear_Stem_Depth} := 2 \text{ ft}$$

$$\text{Rear_Stem_Length} := 3 \text{ ft}$$

Along Bridge Length

$$\text{Rear_WW_Width_Total} := 2 \cdot 2.25 \text{ ft} = 4.50 \text{ ft}$$

$$\text{Rear_WW_Depth} := 514.76 \text{ ft} - 507.29 \text{ ft} = 7.47 \text{ ft}$$

$$\text{Rear_WW_Length} := 1.5 \text{ ft}$$

Along Bridge Length

$$\text{Rear_Vol} := \text{Rear_Abut_Width} \cdot (\text{Rear_Foot_Depth} \cdot \text{Rear_Foot_Length} + \text{Rear_Stem_Depth} \cdot \text{Rear_Stem_Length})$$

$$\text{Rear_Vol} := \text{Rear_Vol} + \text{Rear_WW_Width_Total} \cdot \text{Rear_WW_Depth} \cdot \text{Rear_WW_Length} = 330.9 \text{ ft}^3$$

$$\text{Fwd_Foot_Width} = 13.3333 \text{ ft}$$

$$\text{Fwd_Foot_Depth} := 4 \text{ ft}$$

$$\text{Fwd_Foot_Length} = 7.4167 \text{ ft}$$

Along Bridge Length

$$\text{Fwd_Abut_Width} := 10 \text{ ft} + 2 \cdot 2 \text{ in} = 10.3333 \text{ ft}$$

Does not include Wing Walls

$$\text{Fwd_Stem_Depth} := 512.47 \text{ ft} - 505.80 \text{ ft} = 6.67 \text{ ft}$$

$$\text{Fwd_Stem_Length} := 3 \text{ ft}$$

Along Bridge Length

$$\text{Fwd_WW_Width_Total} := 2 \cdot (1.5 \text{ ft}) = 3 \text{ ft}$$

Total

$$\text{Fwd_WW_Depth} := 514.95 \text{ ft} - 505.80 \text{ ft} = 9.15 \text{ ft}$$

$$\text{Fwd_WW_Length} := 4 \text{ ft} + \left(10 + \frac{5}{16} \right) \text{ in} = 4.8594 \text{ ft}$$

Along Bridge Length

$$\text{Fwd_Vol_Foot} := \text{Fwd_Foot_Width} \cdot (\text{Fwd_Foot_Depth} \cdot \text{Fwd_Foot_Length}) = 395.56 \text{ ft}^3$$

$$\text{Fwd_Vol_Stem} := \text{Fwd_Abut_Width} \cdot (\text{Fwd_Stem_Depth} \cdot \text{Fwd_Stem_Length}) = 206.77 \text{ ft}^3$$

$$Fwd_Vol_WW := Fwd_WW_Width_Total \cdot (Fwd_WW_Depth \cdot Fwd_WW_Length) = 133.39 \text{ ft}^3$$

$$Total_Sub_Conc := \left(\left[\frac{Rear_Vol}{yd^3} \right] + \left[\frac{Fwd_Vol_Foot + Fwd_Vol_Stem}{yd^3} \right] + \left[\frac{Fwd_Vol_WW}{yd^3} \right] \right) yd^3 = 41 \text{ yd}^3$$

511E31611 - CLASS QC2 CONCRETE, SUPERSTRUCTURE, AS PER PLAN

$$Semi_Int_Depth := 514.76 \text{ ft} - 512.29 \text{ ft} = 2.47 \text{ ft}$$

$$Rear_Semi_Int_Overhang_Width := 2 \cdot 11.5 \text{ in} = 1.9167 \text{ ft} \quad \text{Total portion past deck}$$

$$Rear_Semi_Int_Length := 1.5 \text{ ft}$$

$$Rear_Semi_Int := Semi_Int_Depth \cdot (Rear_Semi_Int_Length \cdot (Rear_Abut_Width)) + \\ + Semi_Int_Depth \cdot (Rear_Stem_Length - Rear_Semi_Int_Length) \cdot Rear_Semi_Int_Length = 46.3125 \text{ ft}^3$$

$$Fwd_Semi_Int_Overhang_Width := 2 \cdot 5.5 \text{ in} = 0.9167 \text{ ft} \quad \text{Total portion past deck}$$

$$Fwd_Semi_Int_Length := 1.0 \text{ ft}$$

$$Fwd_Semi_Int := Semi_Int_Depth \cdot (Fwd_Semi_Int_Length \cdot (Fwd_Abut_Width - 2 \cdot 2 \text{ in})) + \\ + Semi_Int_Depth \cdot (Fwd_Stem_Length - Fwd_Semi_Int_Length) \cdot Fwd_Semi_Int_Overhang_Width = 29.2283 \text{ ft}^3$$

$$Deck_Width := 10 \text{ ft}$$

$$Deck_Thick := 6 \text{ in}$$

$$Beam_Length := 62.75 \text{ ft}$$

$$Deck_Vol := Deck_Width \cdot Deck_Thick \cdot Beam_Length = 313.75 \text{ ft}^3$$

$$Avg_Haunch_Thick := \text{Mean} \left(\left[\begin{array}{c} \text{Mean}([1.13 \ 0.15]) \\ \text{Mean}([0.15 \ 0.0]) \end{array} \right] \right) \text{ in} = 0.3575 \text{ in} \quad \text{Total From Geometry Spreadsheet}$$

$$Haunch_Vol := Deck_Width \cdot Avg_Haunch_Thick \cdot Beam_Length = 18.69 \text{ ft}^3$$

$$Total_Super_Vol := \left(\left[\frac{Rear_Semi_Int + Fwd_Semi_Int + Deck_Vol + Haunch_Vol}{yd^3} \right] \right) yd^3 = 16 \text{ yd}^3$$

511E34448 - CLASS QC2 CONCRETE, BRIDGE DECK (PARAPET)

$$Parapet_Width := 1 \text{ ft}$$

$$Parapet_Thick := 2 \text{ ft}$$

$$Bridge_Limits := 65.25 \text{ ft}$$

$$Parapet_Vol := 2 \cdot (Parapet_Width \cdot Parapet_Thick \cdot Beam_Length) = 251.00 \text{ ft}^3$$

$$Parapet_Vol := \left(\left[\frac{Parapet_Vol}{yd^3} \right] \right) yd^3 = 10 \text{ yd}^3$$

512E10000 & 1 - SEALING OF CONCRETE SURFACES AND AS PER PLAN

$$\text{Rear_Seal_Length_Under_Seat} := 1 \text{ ft} + (2.25 \text{ ft}) + 2 \text{ ft} = 5.25 \text{ ft}$$

$$\text{Abut_Width_Under_Seat} := \text{Rear_Abut_Width} - \text{Rear_Semi_Int_Overhang_Width} = 9.08 \text{ ft}$$

$$\text{Rear_Seal_Length_Overhang} := \text{Rear_Seal_Length_Under_Seat} + (514.76 - 512.29) \text{ ft} + 3 \text{ ft} + 3 \text{ in} = 10.97 \text{ ft}$$

$$\text{Rear_Seal_Limits}_1 := \text{Rear_Seal_Length_Under_Seat} \cdot \text{Abut_Width_Under_Seat} + \text{Rear_Seal_Length_Overhang} \cdot \text{Rear_Semi_Int_Overhang_Width} = 68.71 \text{ ft}^2$$

$$\text{Rear_Seal_WW_Length} := 1 \text{ ft} + (2.25 \text{ ft} + 1.5 \text{ ft}) + 2 \text{ ft} + (514.76 - 512.29) \text{ ft} + 1.5 \text{ ft} + 3 \text{ in} = 10.97 \text{ ft}$$

$$\text{Rear_Seal_WW} := \text{Rear_Seal_WW_Length} \cdot \text{Rear_WW_Width_Total} = 49.37 \text{ ft}^2$$

$\text{Rear_Seal_Limits} := \frac{\text{Rear_Seal_Limits}_1 + \text{Rear_Seal_WW}}{\text{yd}^2} \quad \text{yd}^2 = 14 \text{ yd}^2$
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$$\text{Fwd_Seal_Length_Under_Seat} := 4 \text{ ft} + \text{Mean} \left(\left[\begin{array}{l} 2 \text{ ft} + 7.125 \text{ in} \\ 2 \text{ ft} + 9.4375 \text{ in} \end{array} \right] \right) + (512.47 \text{ ft} - 505.80 \text{ ft}) = 13.36 \text{ ft}$$

$$\text{Fwd_Seal_Length_Overhang} := \text{Fwd_Seal_Length_Under_Seat} + (514.95 - 512.47) \text{ ft} + 3 \text{ ft} = 18.84 \text{ ft}$$

$$\text{Fwd_Seal_Left_Abut_Side} := (505.80 \text{ ft} - 505.5 \text{ ft}) \cdot (6 \text{ ft} + 11.5 \text{ in}) = 2.09 \text{ ft}^2$$

$$\text{Fwd_Seal_Limits}' := \text{Fwd_Seal_Length_Under_Seat} \cdot \text{Abut_Width_Under_Seat} + \text{Fwd_Seal_Length_Overhang} \cdot \text{Fwd_Semi_Int_Overhang_Width} + \text{Fwd_Seal_Left_Abut_Side} = 140.71 \text{ ft}^2$$

$\text{Fwd_Seal_Limits} := \frac{\text{Fwd_Seal_Limits}'}{\text{yd}^2} \quad \text{yd}^2 = 16 \text{ yd}^2$

$$\text{Fwd_WW_Front_Seal_Length} := \text{Fwd_Seal_Length_Under_Seat} + (514.95 - 512.47) \text{ ft} + \left(4 \text{ ft} + \left(10 + \frac{5}{16} \right) \text{ in} \right) = 20.70 \text{ ft}$$

$$\text{Fwd_WW_Front_Seal_Area} := \text{Fwd_WW_Front_Seal_Length} \cdot \text{Fwd_WW_Width_Total} = 62.10 \text{ ft}^2$$

$$\text{WW_Side_Seal_Area_Left} := (514.95 \text{ ft} - 505.80 \text{ ft}) \cdot \left(4 \text{ ft} + \left(10 + \frac{5}{16} \right) \text{ in} - 7 \text{ in} \right) = 39.13 \text{ ft}^2$$

$$\text{WW_Side_Seal_Area_Right} := (514.95 \text{ ft} - 510 \text{ ft}) \cdot \left(4 \text{ ft} + \left(10 + \frac{5}{16} \right) \text{ in} \right) = 24.05 \text{ ft}^2$$

$$\text{Fwd_WW_Seal_Limits}' := \text{Fwd_WW_Front_Seal_Area} + \text{WW_Side_Seal_Area_Left} + \text{WW_Side_Seal_Area_Right} = 125.28 \text{ ft}^2$$

$\text{Fwd_WW_Seal_Limits} := \frac{\text{Fwd_WW_Seal_Limits}'}{\text{yd}^2} \quad \text{yd}^2 = 14 \text{ yd}^2$

$\text{Abut_Seal_Limits} := \text{Rear_Seal_Limits} + \text{Fwd_Seal_Limits} + \text{Fwd_WW_Seal_Limits} = 44 \text{ yd}^2$
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$$\text{Bridge_Seal_Side_Mid} := 2 \cdot \text{Parapet_Thick} + \text{Parapet_Width} + \text{Deck_Thick} + \text{Avg_Haunch_Thick} + 6 \text{ in} + 21 \text{ in} + 6 \text{ in} = 8.28 \text{ ft}$$

$$\text{Bridge_Seal_Side_End} := 2 \cdot \text{Parapet_Thick} + \text{Parapet_Width} = 5.00 \text{ ft}$$

$$\begin{aligned} \text{Bridge_Seal} := & 2 \cdot \text{Bridge_Seal_Side_Mid} \cdot (61.75 \text{ ft} - 1.0 \text{ ft} - 1.5 \text{ ft}) + 1041.16 \text{ ft}^2 \\ & + 2 \cdot \text{Bridge_Seal_Side_End} \cdot (3 \text{ ft} + 3 \text{ ft}) \end{aligned}$$

$$\text{Bridge_Seal_Limits} := \left[\frac{\text{Bridge_Seal}}{\text{yd}^2} \right] \text{yd}^2 = 116 \text{ yd}^2$$

$$\text{Rear_Front_Face_MSE_Wall_Seal_Area} := 969.2916 \text{ ft}^2 = 969.29 \text{ ft}^2$$

From CAD

Additional Area for Underside of Coping, Top, and Backface

$$\text{Facing_Underside} := 4.5 \text{ in}$$

$$\text{Coping_Top_Plus_Backside} := 11.5 \text{ in} + 6 \text{ in} = 17.50 \text{ in}$$

$$\begin{aligned} \text{Rear_MSE_Wall_Add_Area} := & (19.2387 + 29.5019 + 32.480) \text{ ft} \cdot (\text{Coping_Top_Plus_Backside}) + 152.87 \text{ ft}^2 \\ & + (19.2387 + 29.5019 + 32.480 + 5.286 \cdot 2) \text{ ft} \cdot \text{Facing_Underside} \end{aligned}$$

$$\text{Total_Rear_MSE_Seal} := \left[\frac{\text{Rear_Front_Face_MSE_Wall_Seal_Area} + \text{Rear_MSE_Wall_Add_Area}}{\text{yd}^2} \right] \text{yd}^2 = 125 \text{ yd}^2$$

$$\text{Fwd_Front_Face_MSE_Wall_Seal_Outside_Area} := 465.79 \text{ ft}^2 + 387.88 \text{ ft}^2 = 853.67 \text{ ft}^2$$

From CAD

$$\text{Fwd_Front_Face_MSE_Wall_Seal_Inside_Area} := 419.16 \text{ ft}^2 = 419.16 \text{ ft}^2$$

$$\begin{aligned} \text{Fwd_Front_Face_MSE_Wall_Seal_Area} := & \text{Fwd_Front_Face_MSE_Wall_Seal_Outside_Area} + 1272.83 \text{ ft}^2 \\ & + \text{Fwd_Front_Face_MSE_Wall_Seal_Inside_Area} \end{aligned}$$

Additional Area for Underside of Coping, Top, and Backface

$$\text{Fwd_Face_MSE_Wall_Seal_Outside_Length} := 60.1422 \text{ ft} + 73.9575 \text{ ft} = 134.10 \text{ ft}$$

$$\text{Fwd_Face_MSE_Wall_Seal_Inside_Length} := 77.01 \text{ ft} = 77.01 \text{ ft}$$

$$\begin{aligned} \text{Fwd_MSE_Wall_Add_Area} := & (\text{Fwd_Face_MSE_Wall_Seal_Outside_Length} + \text{Fwd_Face_MSE_Wall_Seal_Inside_Length}) \cdot 387.0 \text{ ft}^2 \\ & \cdot (\text{Facing_Underside} + \text{Coping_Top_Plus_Backside}) \end{aligned}$$

$$\text{Total_Fwd_MSE_Seal} := \left[\frac{\text{Fwd_Front_Face_MSE_Wall_Seal_Area} + \text{Fwd_MSE_Wall_Add_Area}}{\text{yd}^2} \right] \text{yd}^2 = 185 \text{ yd}^2$$

$$\text{Total_MSE_Seal} := \text{Total_Rear_MSE_Seal} + \text{Total_Fwd_MSE_Seal} = 310 \text{ yd}^2$$

$$\text{Total_Seal} := \text{Abut_Seal_Limits} + \text{Bridge_Seal_Limits} + \text{Total_MSE_Seal} = 470 \text{ yd}^2$$

512E33000 - WATERPROOFING

$$\text{Waterproof_Rear} := \left(\left[\frac{(\text{Rear_WW_Width_Total} + 2 \cdot 1.5 \text{ ft}) \cdot 3 \text{ ft}}{\text{yd}^2} \right] \right) \text{yd}^2 = 3 \text{ yd}^2$$

$$\text{Waterproof_FWD} := \left(\left[\frac{((\text{Fwd_WW_Length} - \text{Fwd_Stem_Length}) + 1.5 \text{ ft}) \cdot 2 \cdot 3 \text{ ft}}{\text{yd}^2} \right] \right) \text{yd}^2 = 3 \text{ yd}^2$$

$$\text{Waterproof} := \text{Waterproof_Rear} + \text{Waterproof_FWD} = 6 \text{ yd}^2$$

515E12020 - PRESTRESSED CONCRETE COMPOSITE BOX BEAM BRIDGE MEMBERS, LEVEL 1, CB17-36 (62'-9" Long)

$$\text{Beams} := 3$$

516E13200 - 1/2" PREFORMED EXPANSION JOINT FILLER

$$\text{Half_PEJF_Rear_Abut} := \text{Rear_Abut_Width} \cdot (6 \text{ in} + 2 \text{ ft} \cdot 4 \%) + (\text{Rear_Abut_Width}) \cdot (6 \text{ in}) = 12 \text{ ft}^2$$

$$\text{Half_PEJF_Rear_WW} := \text{Rear_WW_Width_Total} \cdot (6 \text{ in} + (2 \text{ ft} + 2.25 \text{ ft} + 1.5 \text{ ft}) \cdot 4 \%) + (\text{Rear_WW_Width_Total}) \cdot (6 \text{ in}) = 6 \text{ ft}^2$$

$$\text{Half_PEJF_Rear} := \left(\left[\frac{\text{Half_PEJF_Rear_Abut} + \text{Half_PEJF_Rear_WW}}{\text{ft}^2} \right] \right) \text{ft}^2 = 18 \text{ ft}^2$$

$$\text{PEJF_Height_WW_Right} := 514.95 \text{ ft} - 501.80 \text{ ft} = 13.15 \text{ ft}$$

$$\text{PEJF_Height_WW_Left} := 514.95 \text{ ft} - 505.50 \text{ ft} = 9.45 \text{ ft}$$

$$\text{MSE_Stem_Width} := 7 \text{ in}$$

$$\text{MSE_Cope_Area} := (2 \text{ ft} \cdot 4.5 \text{ in}) = 0.75 \text{ ft}^2$$

$$\text{Half_PEJF_FWD_Walk} := \left(\left[\frac{(\text{PEJF_Height_WW_Right} + \text{PEJF_Height_WW_Left}) \cdot \text{MSE_Stem_Width} + 2 \cdot \text{MSE_Cope_Area}}{\text{ft}^2} \right] \right) \text{ft}^2 = 15 \text{ ft}^2$$

$$\text{Half_PEJF} := \text{Half_PEJF_Rear} + \text{Half_PEJF_FWD_Walk} = 33 \text{ ft}^2$$

516E13600 - 1" PREFORMED EXPANSION JOINT FILLER

$$\text{Inch_PEJF_Abut_Walk} := ((\text{Rear_Abut_Width} + \text{Rear_WW_Width_Total}) + \text{Fwd_Abut_Width}) \cdot (6 \text{ in} - 2 \text{ in}) = 8.61 \text{ ft}^2$$

$$\text{Inch_PEJF_Abut_Walk} := \left(\left[\frac{((\text{Rear_Abut_Width} + \text{Rear_WW_Width_Total}) + \text{Fwd_Abut_Width}) \cdot (6 \text{ in} - 2 \text{ in})}{\text{ft}^2} \right] \right) \text{ft}^2 = 9 \text{ ft}^2$$

$$\text{Inch_PEJF_Abut_Vert} := \left(\left[\frac{2 \cdot (1.5 \text{ ft}) \cdot (514.76 \text{ ft} - 507.29 \text{ ft})}{\text{ft}^2} \right] \right) \text{ft}^2 = 23 \text{ ft}^2$$

$$\text{Inch_PEJF_Barrier} := \text{Inch_PEJF_Abut_Vert} = 23.00 \text{ ft}^2$$

$$\text{Inch_PEJF} := \text{Inch_PEJF_Abut_Walk} + \text{Inch_PEJF_Barrier} = 32.00 \text{ ft}^2$$

516E13900 - 2" PREFORMED EXPANSION JOINT FILLER

$$\text{Two_Inch_PEJF_Rear} := 2 \cdot \text{Rear_WW_Length} \cdot (514.76 \text{ ft} - 512.29 \text{ ft}) = 7.41 \text{ ft}^2$$

$$\text{Two_Inch_PEJF_Fwd} := 2 \cdot \text{Fwd_Stem_Length} \cdot (514.95 \text{ ft} - 512.47 \text{ ft}) = 14.88 \text{ ft}^2$$

$$\text{Two_Inch_PEJF} := \left(\left[\frac{\text{Two_Inch_PEJF_Rear} + \text{Two_Inch_PEJF_Fwd}}{\text{ft}^2} \right] \right) \text{ft}^2 = 23 \text{ ft}^2$$

516E14020 - SEMI-INTEGRAL ABUTMENT EXPANSION JOINT SEAL

$$\text{Abut_Seal_Rear} := \text{Rear_Abut_Width} + 2 \cdot 1.5 \text{ ft} = 14.00 \text{ ft}$$

$$\text{Abut_Seal_Fwd} := \text{Fwd_Abut_Width} + 2 \cdot 1.5 \text{ ft} = 13.33 \text{ ft}$$

$$\text{Two_Inch_PEJF} := \left(\left[\frac{\text{Abut_Seal_Rear}}{\text{ft}} \right] + \left[\frac{\text{Abut_Seal_Fwd}}{\text{ft}} \right] \right) \text{ft} = 28 \text{ ft}$$

516E31010 - 2" DEEP JOINT SEALER

$$\text{JT_Seal} := \left(\left[\frac{((\text{Rear_Abut_Width} + \text{Rear_WW_Width_Total}) + \text{Fwd_Abut_Width})}{\text{ft}} \right] \right) \text{ft} = 26 \text{ ft}$$

516E43100 - ELASTOMERIC BEARING WITH INTERNAL LAMINATES ONLY (NEOPRENE) (8.5"x8"x1.564")

$$\text{Bearings} := 3 \cdot 2 \cdot 2 = 12$$

517E76302 - RAILING, MISC

$$\text{Rail} := ([67.46] + [2.16] + [43.60] + [50.46]) \text{ ft} = 166 \text{ ft}$$

518E21200 - POROUS BACKFILL WITH GEOTEXTILE FABRIC

$$\text{Porous_Rear_Abut} := (514.76 \text{ ft} - 6 \text{ in} - 510.29 \text{ ft}) \cdot \text{Rear_Abut_Width} \cdot 2 \text{ ft} = 3.23 \text{ yd}^3$$

Note that the porous backfill within the MSE Wall does NOT have a special MSE designation. Per the supplement specs

"The Department will measure the 6" Drainage Pipe Perforated and Non-Perforated by the number of feet (meters) installed and accepted. The Department will not measure the backfill or fabric for the drainage pipe for payment. Include this cost in the drainage pipe."

$$\text{Porous} := \left(\left[\frac{\text{Porous_Rear_Abut}}{\text{yd}^3} \right] \right) \text{yd}^3 = 4 \text{ yd}^3$$

518E40000 - 6" PERFORATED CORRUGATED PLASTIC PIPE

$$Rear_PCPP := Rear_Abut_Width = 11 \text{ ft}$$

$$FWD_PCPP := Fwd_Abut_Width + 1 \text{ ft} = 11.33 \text{ ft}$$

$$PCPP := Rear_PCPP + FWD_PCPP = 22.33 \text{ ft}$$

$$PCPP := \left(\left\lceil \frac{Rear_PCPP}{\text{ft}} \right\rceil + \left\lceil \frac{FWD_PCPP}{\text{ft}} \right\rceil \right) \text{ ft} = 23 \text{ ft}$$

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

$$Rear_Abut_NPCPP := 2 \text{ ft} = 2 \text{ ft}$$

$$Rear_Drain_Outlet_NPCPP := 104 \text{ ft}$$

Outlet along Ramp V

Any pipe OUTSIDE the MSE limits, even if needed for MSE Wall drainage, will be paid for with regular quantity.
Measure the distance from the edge of the footing.

$$Fwd_Outside_MSE_NPCPP := 2 \text{ ft} + 6 \text{ in} + 12.75 \text{ ft} + (504 \text{ ft} - 496.50 \text{ ft} - 0.5 \text{ ft}) + 1.5 \text{ ft} = 23.75 \text{ ft}$$

$$NPCPP := \left(\left\lceil \frac{Rear_Abut_NPCPP + Rear_Drain_Outlet_NPCPP}{\text{ft}} \right\rceil + \left\lceil \frac{Fwd_Outside_MSE_NPCPP}{\text{ft}} \right\rceil \right) \text{ ft} = 130 \text{ ft}$$

601E21000 - CONCRETE SLOPE PROTECTION

$$Slope_Protect := \left(\left\lceil \frac{48.83 \text{ ft}^2}{\text{yd}^2} \right\rceil \right) \text{ yd}^2 = 6 \text{ yd}^2$$

607E39911 - 8' VANDAL PROTECTION FENCE

$$VPF_8_Rear := (2.1137 \text{ ft}) + (16.51 \text{ ft}) + (15.42 \text{ ft}) + (3.35 \text{ ft}) = 37.4 \text{ ft}$$

$$VPF_8_Fwd := (9 \text{ ft} + 3.25 \text{ in}) + (2 \text{ ft} + 5.5 \text{ in}) + (64 \text{ ft} + 10.5 \text{ in}) + (15 \text{ ft} + 9.125 \text{ in}) = 92.4 \text{ ft}$$

$$VPF_8 := \left(\left\lceil \frac{VPF_8_Rear}{\text{ft}} \right\rceil + \left\lceil \frac{VPF_8_Fwd}{\text{ft}} \right\rceil \right) \text{ ft} = 131 \text{ ft}$$

607E40000 - 12' VANDAL PROTECTION FENCE

$$VPF_12 := \left(\left\lceil \frac{2 \cdot Bridge_Limits}{\text{ft}} \right\rceil \right) \text{ ft} = 131 \text{ ft}$$

608E13000 - 6" CONCRETE WALK

$$\text{Conc_Walk_6_R_Mid_Walk} := 155.93 \text{ ft}^2$$

$$\text{Conc_Walk_6_R_Left_Shldr} := 166.37 \text{ ft}^2$$

$$\text{Conc_Walk_6_R_Right_Shldr} := 38.48 \text{ ft}^2$$

$$\text{Conc_Walk_6_R_Wall4_Cap} := 57.78 \text{ ft}^2$$

$$\begin{aligned} \text{Conc_Walk_6_Rear} &:= \text{Conc_Walk_6_R_Mid_Walk} + \text{Conc_Walk_6_R_Left_Shldr} + \text{Conc_Walk_6_R_Right_Shldr} + \\ &+ \text{Conc_Walk_6_R_Wall4_Cap} = 418.56 \text{ ft}^2 \end{aligned}$$

$$\text{Conc_Walk_6_Fwd_Mid} := 647.99 \text{ ft}^2$$

$$\text{Conc_Walk_6_Fwd_Off_Bridge} := 211.65 \text{ ft}^2$$

$$\text{Conc_Walk_6} := \left(\left| \frac{\text{Conc_Walk_6_Rear}}{\text{ft}^2} \right| + \left| \frac{\text{Conc_Walk_6_Fwd_Mid} + \text{Conc_Walk_6_Fwd_Off_Bridge}}{\text{ft}^2} \right| \right) \text{ft}^2 = 1279 \text{ ft}^2$$

608E98000 - 10" CONCRETE WALK

$$\text{Conc_Walk_10_Rear_Left} := 28.067 \text{ ft}^2$$

$$\text{Conc_Walk_10_Rear_Right} := 30.95 \text{ ft}^2$$

$$\text{Conc_Walk_10_Rear} := \text{Conc_Walk_10_Rear_Left} + \text{Conc_Walk_10_Rear_Right} = 59.02 \text{ ft}^2$$

$$\text{Conc_Walk_10_Fwd_Outer} := 204.30 \text{ ft}^2$$

$$\text{Conc_Walk_10_Fwd_Inner} := 204.95 \text{ ft}^2$$

$$\text{Conc_Walk_10_Fwd} := \text{Conc_Walk_10_Fwd_Outer} + \text{Conc_Walk_10_Fwd_Inner} = 409.25 \text{ ft}^2$$

$$\text{Conc_Walk_10} := \left(\left| \frac{\text{Conc_Walk_10_Rear}}{\text{ft}^2} \right| + \left| \frac{\text{Conc_Walk_10_Fwd}}{\text{ft}^2} \right| \right) \text{ft}^2 = 470 \text{ ft}^2$$

625E33000 - STRUCTURE GROUNDING SYSTEM

Ground := "1 Each"

840E26000 - CONCRETE COPING

$$Rear_Cope := 81 \text{ ft} + 1.75 \text{ in} = 81.15 \text{ ft}$$

$$Fwd_Cope := (133 \text{ ft} + 10.75 \text{ in} + 76 \text{ ft} + 10.375 \text{ in}) = 210.76 \text{ ft}$$

$$82 + 211 = 293.00$$

$$MSE_Cope := \left(\left\lceil \frac{Rear_Cope}{\text{ft}} \right\rceil + \left\lceil \frac{Fwd_Cope}{\text{ft}} \right\rceil \right) \text{ ft} = 293 \text{ ft}$$

840E20000 - MECHANICALLY STABILIZED EARTH WALL

$$Total_MSE_Rear_Wall := 1534.54 \text{ ft}^2 + 0.6 \text{ ft} \cdot Rear_Cope = 1583.23 \text{ ft}^2$$

From CAD
Footing Dropped 0.6 from CAD.
add this value into the area

$$Total_MSE_Fwd_Wall := (466.86 + 615.81 + 115.98 + 805.86) \text{ ft}^2 = 2004.51 \text{ ft}^2$$

From CAD

From Supplemental Spec:

The Department will determine the area of the MSE wall from plan dimensions using a length measured along the outside of the uppermost facing panels and a height from the top of the concrete leveling pad to the top of the concrete coping.

Therefore leave in the coping height

$$MSE_Wall := \left(\left\lceil \frac{Total_MSE_Rear_Wall}{\text{ft}^2} \right\rceil + \left\lceil \frac{Total_MSE_Fwd_Wall}{\text{ft}^2} \right\rceil \right) \text{ ft}^2 = 3589 \text{ ft}^2$$

840E22000 - FOUNDATION PREPARATION

$$Rear_Found := 772 \text{ ft}^2 = 772.00 \text{ ft}^2$$

From CAD - Area includes 1' offset from the edge of footing as this receives granular material.
Also include Area between shafts

$$Fwd_Found := 1203 \text{ ft}^2 = 1203.00 \text{ ft}^2$$

From CAD - Area excludes the cap and abutment heel.

$$MSE_Found := \left(\left\lceil \frac{Rear_Found}{\text{yd}^2} \right\rceil + \left\lceil \frac{Fwd_Found}{\text{yd}^2} \right\rceil \right) \text{ yd}^2 = 220 \text{ yd}^2$$

840E21000 - WALL EXCAVATION

$$\text{Rear_Wall_Exc} := 362 \text{ yd}^3$$

$$\text{Fwd_Wall_Exc} := 233 \text{ yd}^3$$

$$\text{MSE_Exc} := \text{Rear_Wall_Exc} + \text{Fwd_Wall_Exc} = 595.00 \text{ yd}^3$$

This excavation is from the proposed roadway to the bottom of the proposed footer

From CAD - not sheeting, 1: 1 slope everywhere

From CAD - not sheeting, 1: 1 slope except 2' offset from ROW on East side. near end of walk

840E23050 - NATURAL SOIL

$$\text{Top_Soil_Area_Rear_MSE_Front} := 48.83 \text{ ft}^2$$

Under Slope Protection

$$\text{Soil_Depth_Rear_MSE_Front} := 2 \text{ ft}$$

$$\text{Nat_Soil_Rear_MSE_Front} := \text{Top_Soil_Area_Rear_MSE_Front} \cdot \text{Soil_Depth_Rear_MSE_Front} = 97.66 \text{ ft}^3$$

$$\text{Top_Soil_Area_Rear_MSE_Back} := 405.96 \text{ ft}^2$$

$$\text{Soil_Depth_Rear_MSE_Back} := 2 \text{ ft} + (10 \text{ in} - 6 \text{ in}) = 28.00 \text{ in}$$

Under Assume soil is placed at elevation 2' under the 10" foundation. Subtract off the 4" under foundation area.

$$\text{Subtract_Soil_Area_Rear_MSE_Back} := 30.91 \text{ ft}^2 + 28.07 \text{ ft}^2$$

$$\begin{aligned} \text{Nat_Soil_Rear_MSE_Back} := & \text{Top_Soil_Area_Rear_MSE_Back} \cdot \text{Soil_Depth_Rear_MSE_Back} - \\ & - \text{Subtract_Soil_Area_Rear_MSE_Back} \cdot (10 \text{ in} - 6 \text{ in}) \end{aligned} = 927.58 \text{ ft}^3$$

$$\text{Top_Soil_Area_Fwd_MSE} := 1037.50 \text{ ft}^2$$

$$\text{Top_Soil_Depth_Fwd_MSE} := \text{Soil_Depth_Rear_MSE_Front} = 24.00 \text{ in}$$

$$\text{Subtract_Soil_Area_Fwd_MSE} := 202.79 \text{ ft}^2 + 202.12 \text{ ft}^2$$

$$\begin{aligned} \text{Nat_Soil_Fwd_MSE} := & \text{Top_Soil_Area_Fwd_MSE} \cdot \text{Top_Soil_Depth_Fwd_MSE} - \\ & - \text{Subtract_Soil_Area_Fwd_MSE} \cdot (10 \text{ in} - 6 \text{ in}) \end{aligned} = 1940.03 \text{ ft}^3$$

$$\text{Nat_Soil} := \left(\left[\frac{\text{Nat_Soil_Rear_MSE_Front}}{\text{yd}^3} \right] + \left[\frac{\text{Nat_Soil_Rear_MSE_Back}}{\text{yd}^3} \right] + \left[\frac{\text{Nat_Soil_Fwd_MSE}}{\text{yd}^3} \right] \right) \text{yd}^3 = 111 \text{ yd}^3$$

840E23000 - SELECT GRANULAR BACKFILL

Estimate by taking fill up to top of walk and subtract off the soil are

$$SGB_R_Area_1_DS_Sect := 17.68 \text{ ft}^2$$

$$SGB_R_Area_1_DS_Ht := 509.47 \text{ ft} - (493.70 \text{ ft} - 0.5 \text{ ft}) = 16.27 \text{ ft}$$

$$SGB_R_Area_2_DS_Sect := 25.70 \text{ ft}^2$$

$$SGB_R_Area_2_DS_Ht := 509.17 \text{ ft} - \left(\text{Mean} \left(\left[\begin{array}{c} 496.20 \text{ ft} \\ 493.70 \text{ ft} \end{array} \right] \right) - 0.5 \text{ ft} \right) = 14.72 \text{ ft}$$

$$SGB_R_Area_3_Right_Half_Sect := 134.56 \text{ ft}^2$$

$$SGB_R_Area_3_Right_Half_Ht := \left(\text{Mean} \left(\left[\begin{array}{c} 513.83 \text{ ft} \\ 514.91 \text{ ft} \end{array} \right] \right) - 4 \text{ in} \right) - (493.70 \text{ ft} - 0.5 \text{ ft}) = 20.84 \text{ ft}$$

$$SGB_R_Area_4_Abut_Sect := 134.56 \text{ ft}^2$$

$$SGB_R_Area_4_Abut_Ht := 507.29 \text{ ft} - (491.20 \text{ ft} - 0.5 \text{ ft}) = 16.59 \text{ ft}$$

$$SGB_R_Area_5_Abut_Front_Sect := Top_Soil_Area_Rear_MSE_Front = 48.83 \text{ ft}^2$$

$$SGB_R_Area_5_Abut_Front_Ht := 509.21 \text{ ft} - 6 \text{ in} - (491.20 \text{ ft} - 0.5 \text{ ft}) = 18.01 \text{ ft}$$

$$SGB_R_Area_6_Left_Half_Sect := 144.17 \text{ ft}^2$$

$$Elev_At_MSE_Break_Rear_1 := 514.91 \text{ ft} - \frac{(514.91 \text{ ft} - 513.30 \text{ ft})}{(84.00 \text{ ft} - 53.06 \text{ ft})} \cdot (11 \text{ ft} + 9.25 \text{ in}) = 514.30 \text{ ft}$$

$$SGB_R_Area_6_Left_Half_Ht := \left(\text{Mean} \left(\left[\begin{array}{c} Elev_At_MSE_Break_Rear_1 \\ 514.91 \text{ ft} \end{array} \right] \right) - 4 \text{ in} \right) - (493.70 \text{ ft} - 0.5 \text{ ft}) = 21.07 \text{ ft}$$

$$SGB_R_Area_7_Left_Past_Break_Sect := 107.05 \text{ ft}^2$$

$$SGB_R_Area_7_Left_Past_Break_Ht := \left(\text{Mean} \left(\left[\begin{array}{c} Elev_At_MSE_Break_Rear_1 \\ 513.30 \text{ ft} \end{array} \right] \right) - 4 \text{ in} \right) - \left(\text{Mean} \left(\left[\begin{array}{c} 496.20 \text{ ft} \\ 493.70 \text{ ft} \end{array} \right] \right) - 0.5 \text{ ft} \right) = 19.02 \text{ ft}$$

$$SGB_Rear := \sum \left[\begin{array}{c} SGB_R_Area_1_DS_Sect \cdot SGB_R_Area_1_DS_Ht \\ SGB_R_Area_2_DS_Sect \cdot SGB_R_Area_2_DS_Ht \\ SGB_R_Area_3_Right_Half_Sect \cdot SGB_R_Area_3_Right_Half_Ht \\ SGB_R_Area_4_Abut_Sect \cdot SGB_R_Area_4_Abut_Ht \\ SGB_R_Area_5_Abut_Front_Sect \cdot SGB_R_Area_5_Abut_Front_Ht \\ SGB_R_Area_6_Left_Half_Sect \cdot SGB_R_Area_6_Left_Half_Ht \\ SGB_R_Area_7_Left_Past_Break_Sect \cdot SGB_R_Area_7_Left_Past_Break_Ht \end{array} \right] = 11654.84 \text{ ft}^3$$

$$SGB_F_A_VPI_Out_9085_13385 := 337.62 \text{ ft}^2$$

$$SGB_F_Width_Out_VPI_9085_13385 := 8 \text{ ft} + 4.5 \text{ in}$$

$$SGB_F_A_VPI_Out_6410_8223 := 172.35 \text{ ft}^2$$

$$SGB_F_Width_VPI_6410_8223 := 8 \text{ ft} + 0.5 \text{ in}$$

$$SGB_F_A_VPI_In_1988_7689 := 805.15 \text{ ft}^2$$

$$SGB_F_Width_In_VPI_1988_7689 := 8 \text{ ft}$$

$$SGB_F_A_Behaind_Abut := 104.91 \text{ ft}^2$$

$$SGB_F_Behind_Abut_Ht := \left(\text{Mean} \left(\left[\begin{array}{c} 515.48 \text{ ft} \\ 515.55 \text{ ft} \end{array} \right] \right) - 4 \text{ in} \right) - (502.00 \text{ ft} - 0.5 \text{ ft}) = 13.68 \text{ ft}$$

$$SGB_Fwd := \sum \left(\left[\begin{array}{c} SGB_F_A_VPI_Out_9085_13385 \cdot SGB_F_Width_Out_VPI_9085_13385 \\ SGB_F_A_VPI_Out_6410_8223 \cdot SGB_F_Width_VPI_6410_8223 \\ SGB_F_A_VPI_In_1988_7689 \cdot SGB_F_Width_In_VPI_1988_7689 \\ SGB_F_A_Behaind_Abut \cdot SGB_F_Behind_Abut_Ht \end{array} \right] \right) = 12090.09 \text{ ft}^3$$

Additional area needs to be subtracted from the step in abut Cap and CAP MSE Wall is supported on

$$Abut_Heel_Area := 19.20 \text{ ft}^2$$

$$Abut_Heel_Ht_Diff := 505.80 \text{ ft} - (502.00 \text{ ft} - 0.5 \text{ ft}) = 4.30 \text{ ft}$$

$$SGB_Deduct_Heel_Abut := Abut_Heel_Area \cdot Abut_Heel_Ht_Diff = 82.56 \text{ ft}^3$$

$$Wall_2_Cap_Area := 96.6275 \text{ ft}^2$$

$$Cap_Ht_Diff := 505.50 \text{ ft} - (502.00 \text{ ft} - 0.5 \text{ ft}) = 4.00 \text{ ft}$$

$$SGB_Deduct_Cap := Wall_2_Cap_Area \cdot Cap_Ht_Diff = 386.51 \text{ ft}^3$$

$$SGB' := SGB_Rear + SGB_Fwd - (SGB_Deduct_Heel_Abut + SGB_Deduct_Cap) = 23275.86 \text{ ft}^3$$

Subtract the natural soil

$$SGB_Total := \left(\left[\frac{SGB'}{\text{yd}^3} \right] - \left[\frac{Nat_Soil}{\text{yd}^3} \right] \right) \text{yd}^3 = 752 \text{ yd}^3$$

840E25010 - 6" DRAINAGE PIPE, PERFORATED

$$Rear_MSE_PCPP := (81 \text{ ft} + 1.75 \text{ in}) + 3 \cdot 2.5 \text{ ft} = 88.65 \text{ ft}$$

$$Fwd_MSE_PCPP_Outer := (65 \text{ ft} + 5.25 \text{ in}) + (16 \text{ ft} + 5.5 \text{ in}) + (50 \text{ ft} + 7.5 \text{ in}) = 132.52 \text{ ft}$$

$$Fwd_MSE_PCPP_Inner := (8.00 \text{ ft}) + (67.69 \text{ ft}) = 75.69 \text{ ft}$$

$$MSE_PCPP := \left(\left\lceil \frac{Rear_MSE_PCPP}{\text{ft}} \right\rceil + \left\lceil \frac{Fwd_MSE_PCPP_Outer}{\text{ft}} \right\rceil + \left\lceil \frac{Fwd_MSE_PCPP_Inner}{\text{ft}} \right\rceil \right) \text{ ft} = 298 \text{ ft}$$

840E25020 - 6" DRAINAGE PIPE, NON-PERFORATED

$$Rear_MSE_NPCPP := (1.75) \text{ ft} + (510.29 \text{ ft} - 493.70 \text{ ft}) = 18.34 \text{ ft}$$

Vertical Pipe and the outlet
through wall past footer

$$Fwd_MSE_NPCPP := 9 \text{ ft} + 4 \text{ in} = 9.33 \text{ ft}$$

$$MSE_NPCPP := \left(\left\lceil \frac{Rear_MSE_NPCPP}{\text{ft}} \right\rceil + \left\lceil \frac{Fwd_MSE_NPCPP}{\text{ft}} \right\rceil \right) \text{ ft} = 29 \text{ ft}$$

840E26050 - AESTHETIC SURFACE TREATMENT

$$MSE_Aesthetic := MSE_Wall = 3589 \text{ ft}^2$$

Treatment goes to bottom of wall - so
same area as MSE

840E27000 - ON-SITE ASSISTANCE

$$On_Site := 5$$

840E28000 - SGB INSPECTION AND COMPACTION TESTING

$$SGB_Test := \text{"Lump Sum"}$$