DESIGN CRITERIA:

AASHTO simplified method MSE wall for extensible reinforcement and coherent gravity method for inextensible reinforcement.

ϕ=34° — Class I Backfill friction angle

γsoil=125(LB/CF) — PCF unit weight with 95% AASHTO T180

γh=1.5 — Horizontal Earth Pressure Factor

γv=1.35 — Vertical Earth Pressure Factor

dmax=2" — CDOT Class I Backfill Max Size

RL(z) — Reinforcement Length

$$Kaf=\cos(\beta)\times\frac{\cos(\beta)-\sqrt{\cos^2(\beta)-\cos^2(\phi)}}{\cos(\beta)+\sqrt{\cos^2(\beta)-\cos^2(\phi)}}$$ — Rankine Active Earth Pressure Kaf

Where β=atan(0.5) — With 2(H)(Min.) to 1(V) Back slope

$$Rv(z)=\tfrac{1}{2}\times\gamma v\times\gamma soil\times RL(z)\times\tan(\beta)+\gamma v\times\gamma soil\times Z$$ — Resultant of Soil

$$\sigma AH1(z,DH)=\tfrac{1}{2}Kaf\times\gamma h\times\gamma soil\times[z+RL(DH)\times\tan(\beta)]^2$$

$$Mo(z)=\tfrac{1}{3}(z+RL(z)\times\tan(\beta))\times\cos(\beta)\times\sigma AH1$$ — Overturning Moment

$$Mr(z)=Rv(z)\times\frac{RL(z)^2}{2}+RL(z)\times\sin(\beta)\times sAH1$$ — Righting Moment

$$Ecc(z)=\frac{RL(z)}{2}-\frac{Mr(z)-Mo(z)}{Rv(z)\times RL(z)+\sin(\beta)\times\sigma AH1}$$ — Eccentricity of Resultant

$\sigma v1(z)=Rv(z)$ — Overburden

$\sigma v2(z)=Rv(z)/\gamma v$ — Unfactored Overburden

$\sigma H(z)=\sigma v1(z)\times Kaf\times GRSfactor$ — Lateral earth pressure AASHTO LRFD Eq 11.10.6.2.1-1 (LB./FT.)

$Sum\sigma h(z)=\sigma H(z)\times spacing(z)$ — Summation of Eq 11.10.6.2.1-1

$$Tmax(z)=\frac{\sigma H(z)\times spacing(z)}{12}$$ — AASHTO LRFD Eq 11.10.6.2.1-2

α=0.6 — Scale Correction Factor

Rc=1.0 — Coverage Ratio

ϕp=0.9 — Resistance Factor Reinforcing Pullout

Cp=2.0 — Both Top and Bottom

Fp=0.67×Tan(ϕ) — Pullout Friction Factor

$$Le(z)=\frac{Tmax(z)}{\phi p\times Fp\times\alpha\times\sigma v2(z)\times Cp\times Rc}$$ — AASHTO LRFD Eq 11.10.6.3.2-1

$$Bear(z)=\tfrac{1}{2}\times\tfrac{1}{1000}\times\frac{RL(z)\times Rv(z)+\sin(\beta)\times\sigma AH1}{RL(z)-2\times ecc(z)}$$ — AASHTO LRFD Eq 11.6.3.2.-1 (Bearing Pressure in TSF)

GRSspacing=8" — Soil reinforcement spacing including short tail reinforcements

$$GRSfactor=\left[\frac{1}{0.7\,[GRSspacing/(6\times dmax)]}\right]=1.268$$ — GRS wall factor (FHWA-HRT-11-026 Eq 31)

With the accompanied earthquake (EQ) resistance wall details, MSE wall design without EQ load combination meets LRFD Seismic Performance Zones (SPZ) 1 through 3. For avoiding sesmic induced backfill leaks due to roadway tension cracks, block topping or panel splitting; these details including coping, extended top two layers of soil reinforcing, panel joint, rail anchor slab/beam, leveling pad and end of wall treatment shall be used.

Table values are per linear feet of wall.

DH or Z (Ft)	SPACING* RL TYPE	σH (Lb/Ft)	ΣσH×spacing** (Lb/Ft)	Tmax	Le (Ft)
0.667	12" TO	666.668	444.445	666.668	1.425
1.333	16" TO	724.639	927.538	966.185	1.900
2.000	N/A TA	782.61	1.45E+03	NA	NA
2.667	16" F	840.581	2.01E+03	1.12E+03	1.900
3.333	N/A TA	898.552	2.61E+03	NA	NA
4.000	16" F	956.523	3.25E+03	1.28E+03	1.900
4.667	N/A TA	1.01E+03	3.92E+03	NA	NA
5.333	16" F	1.07E+03	4.64E+03	1.43E+03	1.900
6.000	N/A TA	1.13E+03	5.39E+03	NA	NA
6.667	16" F	1.19E+03	6.18E+03	1.59E+03	1.900
7.333	N/A TA	1.25E+03	7.02E+03	NA	NA
8.000	16" F	1.30E+03	7.88E+03	1.74E+03	1.900
8.667	N/A TA	1.36E+03	8.79E+03	NA	NA
9.333	16" F	1.42E+03	9.74E+03	1.89E+03	1.900
10.000	N/A TA	1.48E+03	1.07E+04	NA	NA
10.667	16" F	1.54E+03	1.18E+04	2.05E+03	1.900
11.333	N/A TA	1.59E+03	1.28E+04	NA	NA
12.000	12" F	1.65E+03	1.39E+04	1.65E+03	1.425
12.667	8" F	1.71E+03	1.51E+04	1.14E+03	0.950
13.333	8" F	1.77E+03	1.62E+04	1.18E+03	0.950
14.000	8" F	1.83E+03	1.75E+04	1.22E+03	0.950
14.667	8" F	1.88E+03	1.87E+04	1.26E+03	0.950
15.333	8" F	1.94E+03	2.00E+04	1.30E+03	0.950
16.000	8" F	2.00E+03	2.13E+04	1.33E+03	0.950
16.667	8" F	2.06E+03	2.27E+04	1.37E+03	0.950
17.333	8" F	2.12E+03	2.41E+04	1.41E+03	0.950
18.000	8" F	2.17E+03	2.56E+04	1.45E+03	0.950
18.667	8" F	2.23E+03	2.71E+04	1.49E+03	0.950
19.333	8" F	2.29E+03	2.86E+04	1.53E+03	0.950
20.000	8" F	2.35E+03	3.01E+04	1.57E+03	0.950
20.667	8" F	2.41E+03	3.18E+04	1.60E+03	0.950
21.333	8" F	2.46E+03	3.34E+04	1.64E+03	0.950
22.000	8" F	2.52E+03	3.51E+04	1.68E+03	0.950
22.667	8" F	2.58E+03	3.68E+04	1.72E+03	0.950
23.333	8" F	2.64E+03	3.86E+04	1.76E+03	0.950
24.000	8" F	2.70E+03	4.04E+04	1.80E+03	0.950
24.667	8" F	2.75E+03	4.22E+04	1.84E+03	0.950
25.333	8" F	2.81E+03	4.41E+04	1.87E+03	0.950
26.000	8" F	2.87E+03	4.60E+04	1.91E+03	0.950
26.667	8" F	2.93E+03	4.79E+04	1.95E+03	0.950
27.333	8" F	2.99E+03	4.99E+04	1.99E+03	0.950
28.000	8" F	3.04E+03	5.19E+04	2.03E+03	0.950
28.667	8" F	3.10E+03	5.40E+04	2.07E+03	0.950
29.333	8" F	3.16E+03	5.61E+04	2.11E+03	0.950
30.000	8" F	3.22E+03	5.83E+04	2.15E+03	0.950
30.667	8" F	3.28E+03	6.04E+04	2.18E+03	0.950
31.333	8" F	3.33E+03	6.27E+04	2.22E+03	0.950
32.000	8" F	3.39E+03	6.49E+04	2.26E+03	0.950
32.667	8" F	3.45E+03	6.72E+04	2.30E+03	0.950
33.333	8" F	3.51E+03	6.96E+04	2.34E+03	0.950
34.000	8" F	3.57E+03	7.19E+04	2.38E+03	0.950
34.667	8" F	3.62E+03	7.44E+04	2.42E+03	0.950
35.333	8" F	3.68E+03	7.68E+04	2.45E+03	0.950
36.000	8" F	3.74E+03	7.93E+04	2.49E+03	0.950
36.667	8" F	3.80E+03	8.18E+04	2.53E+03	0.950
37.333	8" F	3.86E+03	8.44E+04	2.57E+03	0.950
38.000	8" F	3.91E+03	8.70E+04	2.61E+03	0.950
38.667	8" F	3.97E+03	8.97E+04	2.65E+03	0.950
39.333	8" F	4.03E+03	9.24E+04	2.69E+03	0.950
40.000	4" F	4.09E+03	9.51E+04	1.36E+03	0.475

Table is for DH=40'; conservatively applied to walls with DH≤40'.

* Example spacing and RL Type. Full(F);Tail(TA);Top(TO)

** Summation of σH above Z for DH=40' only

EXAMPLES:

Biaxial HDPE & PP geotextiles with ultimate strengths of 4,800, 7,800, and 12,000 Lb/Ft are used for soil reinforcing layers. See CDOT B504 Standard Special for K Values

1. $T_{al}=T_{ult}\times K$
   K=27%(HDPE & PP)

2. Given:
   a. Check Tmax for DH=16', Z=10.667', spacing=16", RC=1 (For 100% coverage) and Φ=0.9 Tmax≤ΦT_{al} Rc AASHTO 11.10.6.4.1-1
   Tmax =σH×Spacing=1171x16/12=1561 Lb/Ft
   1561 Lb/Ft < 7800x0.27=2106 Lb/Ft

   b. The 16' high wall has 8 layers of tails and 16 full layers, neglecting tail contribution check sum of all layers. ΣσH= 16x2106 = 3.37×10^4 Lb/Ft > 1.55×10^4 Lb/Ft

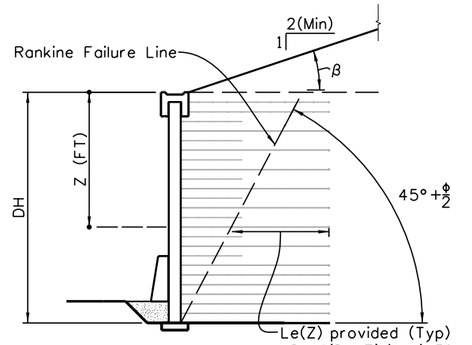
3. DH=40', Check z=39.333

   a. Tmax = σH×Spacing= 2686 < 12000x0.27 =3240 Lb/Ft

   b. ΣσH×spacing; 21x3240 (12,000 HDPE) + 9x2106 (7,800 HDPE) + 21x1296 (4,800 PP) = 114,210 Lb/Ft > 92,400 (From table)

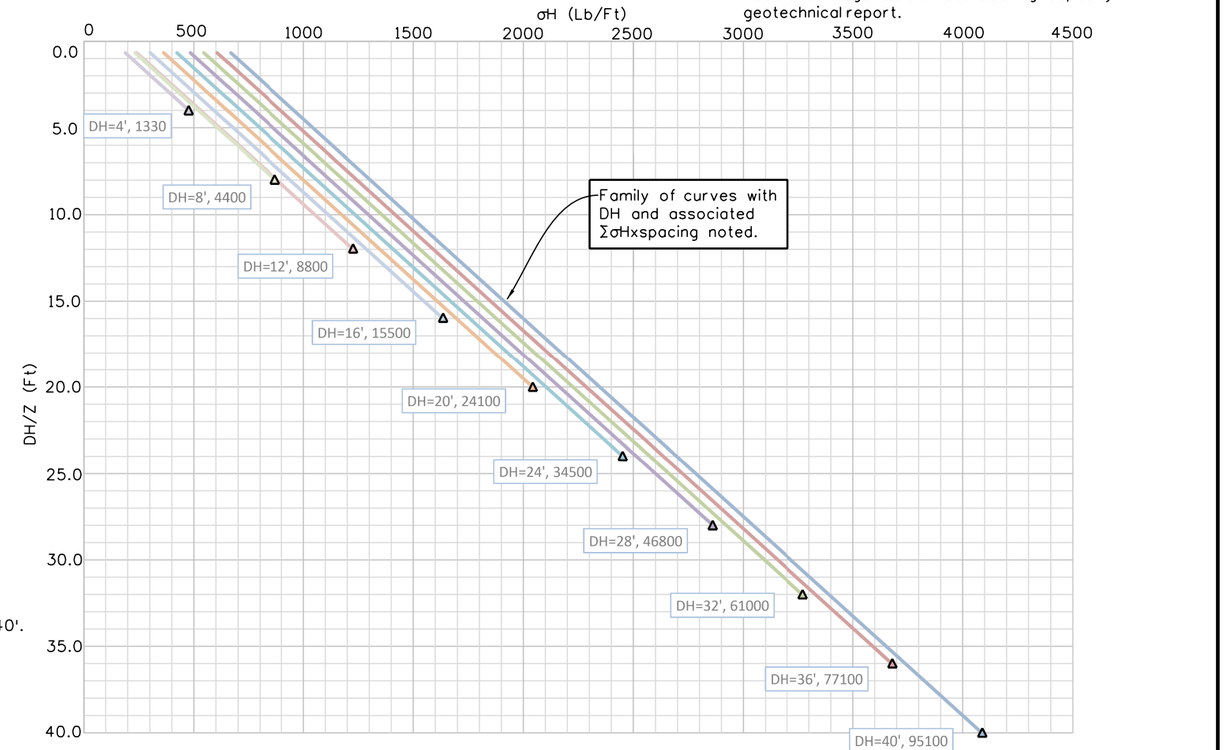
4. Check top layer pull out requirement for DH=6' Truncated Base wall on B-504-N3. Le=1.92' and Le(provided with 2 LR)=6-(6-.667)/tan(45+34/2)=3.16'

B-504-03
(This sheet must be accompanied by B-504-N1, N2 or N3)



APPLICATION DIAGRAM (DH=16' AS SHOWN)

5. Factored bearing pressure (BP) for DH=40'
   From B-504-N1 BP=6.808 TSF
   From B-504-N2 BP=13.218 TSF
   From B-504-N3 BP=13.644 TSF
   Must check against ultimate bearing capacity in geotechnical report.



Revision Dates: 09-16, 10-24

INITIALS	DESIGN	DATE	DETAIL	DATE	QUANTITY	DATE
By						
Checked By						

All seals for this set of drawings are applied to the cover page(s)

Print Date: $DATE$
File Name: Sheet_B-504-03.dgn
Horiz. Scale: Vert. Scale: As Noted
Unit Information Unit Leader Initials

Sheet Revisions		
Date:	Comments	Init.

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As Constructed
No Revisions:
Revised:

LRFD GRS WALL WITH ROADWAY RAIL DESIGN CHARTS/TABLE

Designer: XXXXXXXX
Structure Numbers: XXXXXXXXXXXXX

Project No./Code

$PLOT_INFO$