

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

$$K_{af} = \cos(\beta) \times \frac{\cos(\beta) - \sqrt{\cos^2(\beta) - \cos^2(\phi)}}{\cos(\beta) + \sqrt{\cos^2(\beta) - \cos^2(\phi)}}$$

Rankine Active
Earth Pressure K_{af}

$$R_v(z) = \frac{1}{2} \times \gamma_v \times \gamma_{soil} \times RL(z) \times \tan(\beta) + \gamma_v \times \gamma_{soil} \times Z$$

Resultant of Soil

$$\sigma_{AH1}(z, DH) = \frac{1}{2} K_{af} \times \gamma_h \times \gamma_{soil} \times [z + RL(DH) \times \tan(\beta)]^2$$
$$Mr(z) = R_v(z) \times \frac{RL(z)^2}{2} + RL(z) \times \sin(\beta) \times sAH1 \quad \text{Righting Moment}$$
$$E_{cc}(z) = \frac{RL(z)}{2} - \frac{Mr(z) - Mo(z)}{Rv(z) \times RL(z) + \sin(\beta) \times \sigma AHI}$$

Eccentricity of Resultant

$$\sigma v_1(z) = R v_1(z) \quad \text{Überburden}$$

$$\sigma_v^2(z) = R_v(z) / \gamma_v$$

Unfactored Overburden

$$\sigma_H(z) = \sigma_{v1}(z) \times K_{af} \times \text{GRSfactor}$$

Lateral earth pressure AASHTO LRFD Eq 11.10.6.2.1-1 (LB./FT.)

Sumσh(z)= σH(z)×spacing(z) Summation of Eq. 11.10.6.2.1-1

$$T_{\max}(z) = \frac{\sigma_H(z) \times \text{spacing}(z)}{12} \quad \text{AASHTO LRFD Eq 11.10.6.2.1-2}$$

$\alpha=0.6$ Scale Correction Factor

Rc=1.0 Coverage Ratio

$\phi_p=0.9$ Resistance Factor Reinforcing Pullout

Cp=2.0 Both Top and Bottom

$$F_p = 0.67 \times \tan(\phi)$$
 Pullout Friction Factor
$$Le(z) = \frac{T_{max}(z)}{\phi_p \times F_p \times \alpha \times \sigma_v^2(z) \times C_p \times R_c} \quad \text{AASHTO LRFD Eq 11.10.6.3.2-1}$$
$$\text{Bear}(z) = \frac{1}{2} \times \frac{1}{1000} \times \frac{\text{RL}(z) \times \text{Rv}(z) + \sin(\beta) \times \sigma_{\text{AH1}}}{\text{RL}(z) - 2 \times \text{ecc}(z)} \quad \begin{array}{l} \text{AASHTO LRFD} \\ \text{Eq 11.6.3.2.-1} \\ (\text{Bearing Pressure in TSF}) \end{array}$$

GRSspacing=8" Soil reinforcement spacing including short tail reinforcements

$$\text{GRSfactor} = \left[\frac{1}{0.7 [\text{GRSspacing} / (6 \times \text{dmax})]} \right] = 1.268$$

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 seismic 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	*		**		Tmax	Le (Ft)
	SPACING RL TYPE	σH (Lb/Ft)	ΣσHxspacing (Lb/Ft)			
0.667	12"	T	666.668	444.445	666.668	1.425
1.333	16"	T	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

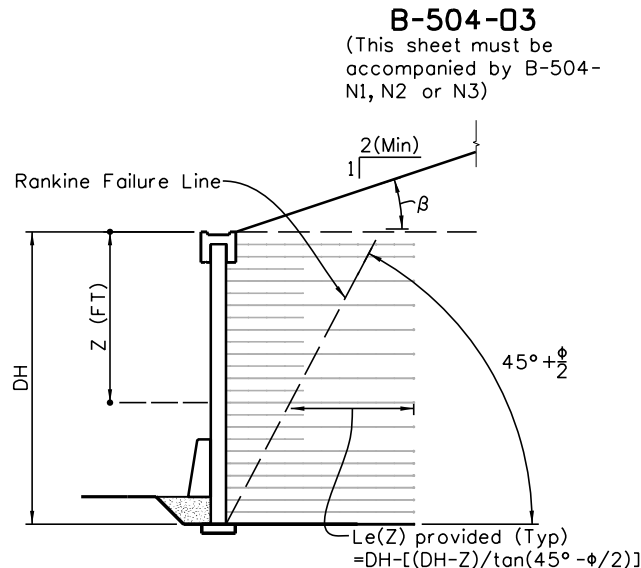
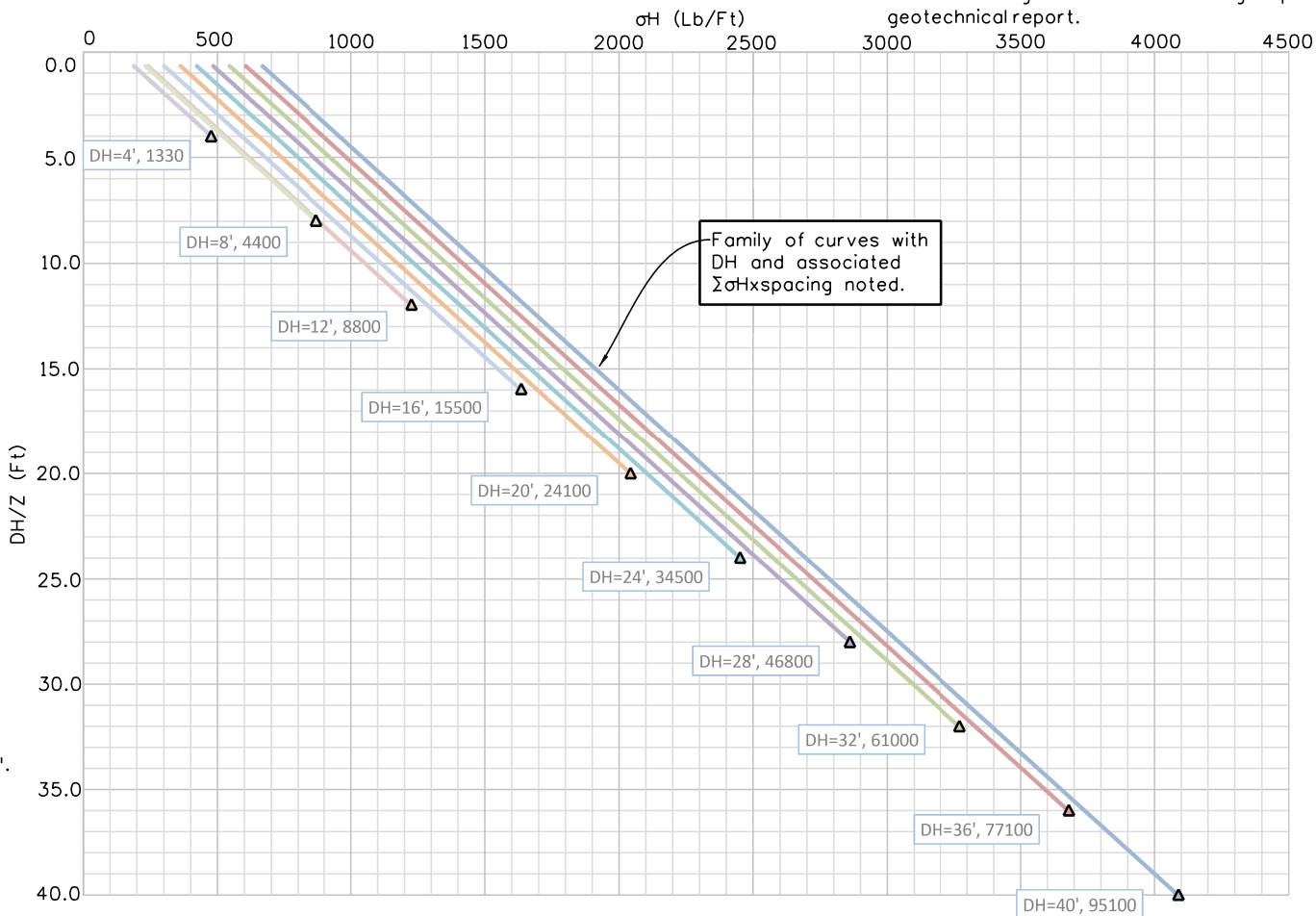
Table is for $DH=40'$; conservatively applied to walls with $DH \leq 40'$.

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

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

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. $T_{dl} = T_{ult} \times K$
 $K = 27\% (\text{HDPE} \ \& \ \text{PP})$
2. Given:
 - a. Check T_{max} for $DH=16'$, $Z=10.667'$, spacing=16", $RC=1$ (For 100% coverage) and $\phi=0.9$ $T_{max} \leq \phi T_{dl}$ Rc AASHTO 11.10.6.4.1-1
 $T_{max} = \sigma_H \times \text{Spacing} = 1171 \times 16 \frac{1}{12} = 1561 \text{ Lb/Ft}$
 $1561 \text{ Lb/Ft} < 7800 \times 0.27 = 2106 \text{ Lb/Ft}$
 - b. The 16' high wall has 8 layers of tails and 16 full layers, neglecting tail contribution check sum of all layers. $\Sigma \sigma_H = 16 \times 2106 = 3.37 \times 10^4 \text{ Lb/Ft}$
 $> 1.55 \times 10^4 \text{ Lb/Ft}$
3. $DH=40'$, Check $z=39.333$
 - a. $T_{max} = \sigma_H \times \text{Spacing} = 2686 < 12000 \times 0.27 = 3240 \text{ Lb/Ft}$
 - b. $\Sigma \sigma_H \times \text{spacing}$; 21×3240 (12,000 HDPE) + 9×2106 (7,800 HDPE) + 21×1296 (4,800 PP) = 114,210 Lb/Ft $> 92,400$ (From table)
4. Check top layer pullout requirement for $DH=6'$ Truncated Base wall on B-504-N3. $Le=1.92'$ and Le (provided with 2 LR)= $6-(6-.667)/\tan(45+34/2)=3.16'$



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\$		Sheet Revisions			Colorado Department of Transportation	As Constructed	LRFD GRS WALL WITH ROADWAY RAIL DESIGN CHARTS/TABLE		Project No./Code	
	File Name: Sheet_B-504-O3.dgn		Date:	Comments	Init.	 2829 West Howard Place, 3rd Floor Denver, CO 80204 Phone: 303-512-4079 FAX: 303-757-9197	No Revisions:				
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