

Note to Designer: Update design for current MASH loads.

$\phi=34^\circ$	Class I Backfill friction angle
ysoil=125(LB/CF)	PCF unit weight with 95% AASHTO T180
yh=1.5	Horizontal Earth Pressure Factor
yv=1.35	Vertical Earth Pressure Factor
LS=1.75	Live Load Surcharge Factor
LLSurq=2'	Live Load Surcharge
dmax=2"	CDDT Class I Backfill Max Size
HMAthk=12"	HMA Thickness
hma=140(LB/CF)	HMA unit weight
gammaHMA= max:1.5 min:0.65	HMA design factor
$Ka=\frac{1-\sin(\phi)}{1+\sin(\phi)}$	Active Earth Pressure Coefficient Ka

$$\begin{aligned} Mo(z) &= \frac{1}{6} \times K_a \times \gamma h \times \gamma_{soil} \times z^3 + \frac{1}{2} \times K_a \times L S_x \times R L \times \gamma_{soil} \times L L S u r g \times z^2 && \text{Overturning Moment} \\ &&& \text{(Use } \gamma_{soil} \text{ for HMA)} \\ Mr(z) &= Rv(z) \times RL(z)^2 / 2 && \text{Righting Moment} \end{aligned}$$
$$\sigma v_1(z) = \gamma v \times \gamma \text{soil} \times (z - \frac{\text{HMAthk}}{12}) \quad \text{Overburden with LS} \\ + \gamma \text{HMAmax} \times \text{xhmax} \times \frac{\text{HMAthk}}{12} + \text{LS} \times \gamma \text{soil} \times \text{LLSurg}$$
$$\sigma_H(z) = K_a \times \sigma_{v1}(z) \times \text{GRSfactor}$$

AASHTO LRFD Eq 11.10.6.2.1-1
(Lb/Ft)

$$\sigma_h(z) = \begin{cases} \sigma_h(z) + \text{Rail Impact} & \text{if } z \leq 2 \\ \sigma_h(z) & \text{otherwise} \end{cases}$$
$$T_{\max}(z) = \frac{\sigma(z) \times \text{spacing}(z)}{12} \quad \text{AASHTO LRFD Eq 11.10.6.2.1-2}$$

$\alpha=0.6$	Scale	Correction Factor
$R_c=1.0$		Coverage Ratio
$\phi_p=0.9$	Resistance Factor	Reinforcing Pullout
$C_p=2.0$		Both Top and Bottom
$F_p=0.67 \times \tan(\phi)$		Pullout Friction Factor

$$Le(z) = \frac{T_{max}(z)}{(\phi_p \times F_p \times \alpha \times \sigma_{v2}(z) \times C_p \times R_c)} \quad \text{AASHTO LRFD Eq 11.10.6.3.2-1}$$
$$\text{Bear}(z) = 1/2 \times 1/1000 \times \frac{R_v(z) \times RL(z)}{(RL(z) - 2 \times \text{ecc}(z))}$$

AASHTO LRFD Eq 11.6.3.2.-1
(Bearing Pressure in TSF)

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.

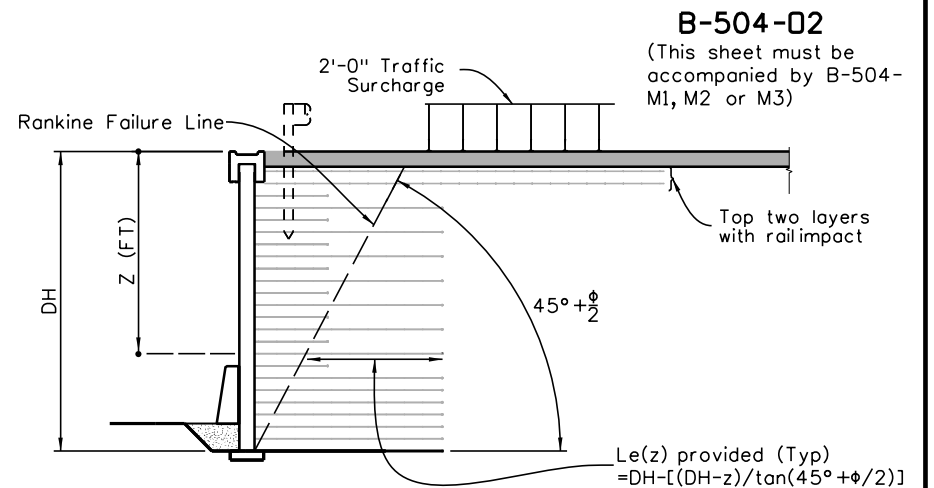
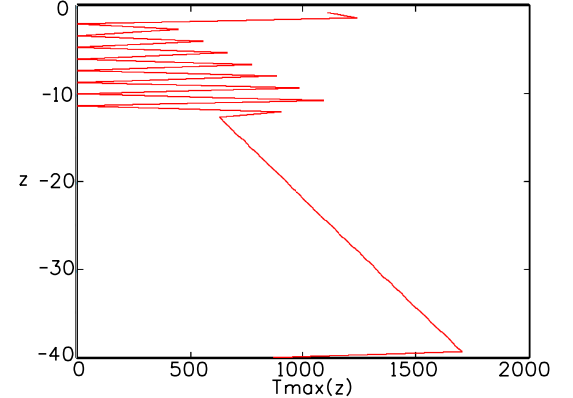
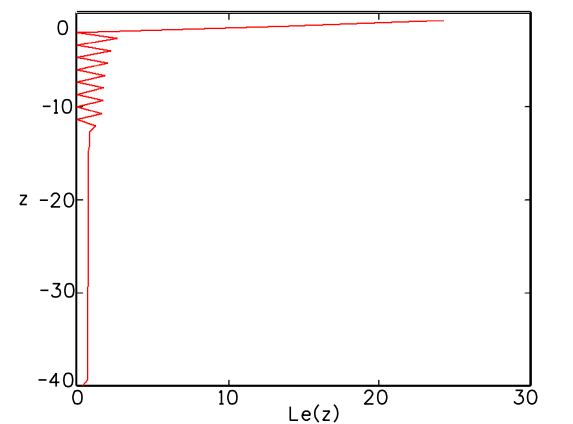
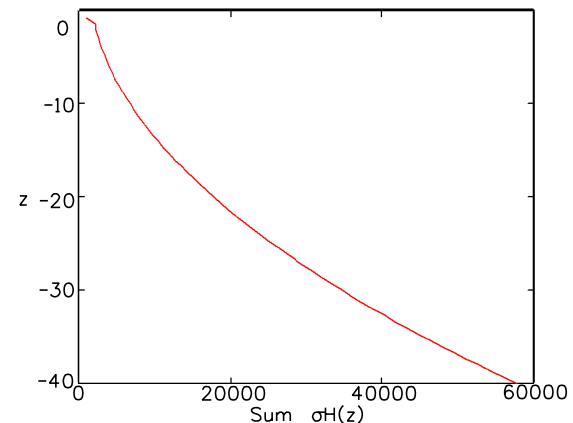
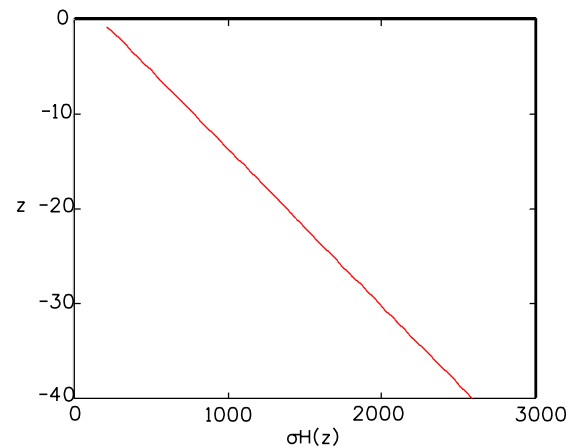
Table values are per linear feet of wall.

DH or Z (Ft)	# OF BLOCKS	σH (Lb/Ft)	ΣσH×spacing (Lb/Ft)	RL TYPE	SPAC- ING	Le (Ft)
0.667	Coping	207.095	1.04E+03	TOP	12"	24.303
1.333	2	252.368	2.11E+03	TOP	16"	13.945
2.000	3	292.712	2.30E+03	TAIL	N/A	NA
2.667	4	333.055	2.52E+03	FULL	16"	2.612
3.333	5	373.398	2.77E+03	TAIL	N/A	NA
4.000	6	413.741	3.05E+03	FULL	16"	2.195
4.667	7	454.084	3.35E+03	TAIL	N/A	NA
5.333	8	494.427	3.68E+03	FULL	16"	1.981
6.000	9	534.77	4.04E+03	TAIL	N/A	NA
6.667	10	575.113	4.42E+03	FULL	16"	1.852
7.333	11	615.456	4.83E+03	TAIL	N/A	NA
8.000	12	655.799	5.27E+03	FULL	16"	1.765
8.667	13	696.143	5.73E+03	TAIL	N/A	NA
9.333	14	736.486	6.22E+03	FULL	16"	1.703
10.000	15	776.829	6.74E+03	TAIL	N/A	NA
10.667	16	817.172	7.29E+03	FULL	16"	1.656
11.333	17	857.515	7.86E+03	TAIL	N/A	NA
12.000	18	897.858	8.46E+03	FULL	12"	1.214
12.667	19	938.201	9.08E+03	FULL	8"	0.802
13.333	20	978.544	9.73E+03	FULL	8"	0.795
14.000	21	1.02E+03	1.04E+04	FULL	8"	0.789
14.667	22	1.06E+03	1.11E+04	FULL	8"	0.783
15.333	23	1.10E+03	1.19E+04	FULL	8"	0.778
16.000	24	1.14E+03	1.26E+04	FULL	8"	0.773
16.667	25	1.18E+03	1.34E+04	FULL	8"	0.768
17.333	26	1.22E+03	1.42E+04	FULL	8"	0.764
18.000	27	1.26E+03	1.51E+04	FULL	8"	0.760
18.667	28	1.30E+03	1.59E+04	FULL	8"	0.757
19.333	29	1.34E+03	1.68E+04	FULL	8"	0.754
20.000	30	1.38E+03	1.77E+04	FULL	8"	0.751
20.667	31	1.42E+03	1.87E+04	FULL	8"	0.748
21.333	32	1.46E+03	1.97E+04	FULL	8"	0.745
22.000	33	1.50E+03	2.07E+04	FULL	8"	0.742
22.667	34	1.54E+03	2.17E+04	FULL	8"	0.740
23.333	35	1.58E+03	2.28E+04	FULL	8"	0.738
24.000	36	1.62E+03	2.38E+04	FULL	8"	0.736
24.667	37	1.66E+03	2.49E+04	FULL	8"	0.734
25.333	38	1.71E+03	2.61E+04	FULL	8"	0.732
26.000	39	1.75E+03	2.72E+04	FULL	8"	0.730
26.667	40	1.79E+03	2.84E+04	FULL	8"	0.728
27.333	41	1.83E+03	2.97E+04	FULL	8"	0.727
28.000	42	1.87E+03	3.09E+04	FULL	8"	0.725
28.667	43	1.91E+03	3.22E+04	FULL	8"	0.724
29.333	44	1.95E+03	3.35E+04	FULL	8"	0.722
30.000	45	1.99E+03	3.48E+04	FULL	8"	0.721
30.667	46	2.03E+03	3.61E+04	FULL	8"	0.720
31.333	47	2.07E+03	3.75E+04	FULL	8"	0.718
32.000	48	2.11E+03	3.89E+04	FULL	8"	0.717
32.667	49	2.15E+03	4.04E+04	FULL	8"	0.716
33.333	50	2.19E+03	4.18E+04	FULL	8"	0.715
34.000	51	2.23E+03	4.33E+04	FULL	8"	0.714
34.667	52	2.27E+03	4.48E+04	FULL	8"	0.713
35.333	53	2.31E+03	4.64E+04	FULL	8"	0.712
36.000	54	2.35E+03	4.79E+04	FULL	8"	0.711
36.667	55	2.39E+03	4.95E+04	FULL	8"	0.710
37.333	56	2.43E+03	5.11E+04	FULL	8"	0.709
38.000	57	2.47E+03	5.28E+04	FULL	8"	0.708
38.667	58	2.51E+03	5.45E+04	FULL	8"	0.708
39.333	59	2.55E+03	5.62E+04	FULL	8"	0.707
40.000	60	2.59E+03	5.79E+04	FULL	4"	0.351

Note: Le of top two layers are not developed, layers used for avoiding roadway tension cracks.

* Summation of σ_H above Z includes rail impact.

**** Tributary spacing**



EXAMPLES:

Biaxial woven polyester (PET) geotextiles with ultimate strengths of 4,800 & 7,200 Lb./Ft. are used for soil reinforcing layers. See CDOT B504 Standard Special for K Values

1. $T_{al} = T_{ult} \times K$
 $K = 30\%(\text{PET})$
2. Given:
 - a. Check T_{max} for $DH=16'$, $Z=10.667'$, spacing= $16''$, $R_c=1$ (For 100% coverage) $T_{max} \leq T_{al} R_c$ AASHTO 11.10.6.4.1-1
 $T_{max} = \sigma H \times \text{Spacing} = 817.172 \times \frac{16}{12} = 1089.56 \text{ Lb/Ft.}$
 $1089.56 \text{ Lb/Ft} < 1440 \text{ Lb/Ft.}$
 - b. The 16' high wall has 8 layers of tails and 16 full layers, neglecting tail contribution check sum of all layers. $\Sigma \sigma H = 16 \times 1440 = 2.30 \times 10^4 \text{ Lb/Ft}$
 $> 1.26 \times 10^4 \text{ Lb/Ft.}$
3. $DH=40'$, Check $z=39.333$
 - a. $T_{max} = \sigma H \times \text{Spacing} = 2.55 \times 10^4 \times \frac{8}{12} = 1700 \text{ VS } 2160 \text{ Lb/Ft}$
 - b. $\Sigma \sigma H \times \text{spacing}; 31 \text{ (Full Layers)} \times 1440 + 12 \times 2160 =$
 $8.20 \times 10^4 \text{ Lb/Ft} > 5.79 \times 10^4 \text{ Lb/Ft}$
4. Neglect the top layer pullout requirement for $DH=6'$ Truncated Base wall on B-504-G3. Check the third layer down $z=2.667'$, L_e (Required from Table)
 $= 2.612'$, $L_e(\text{Provided}) = 6' - (6 - 2.667') / \tan(45^\circ + \frac{\phi}{2}) = 6 - 1.772 = 4.228' > 2.612'$
5. Factored bearing pressure (BP) for $DH=40'$
 From B-504-M1 BP=4.721 TSF
 From B-504-M2 BP=9.596 TSF
 From B-504-M3 BP=8.850 TSF
 Must check against ultimate bearing capacity in geotechnical report.

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-504-02.dgn		Date:	Comments	Init.	 2829 West Howard Place, 3rd Floor Denver, CO 80204 Phone: 303-512-4079 FAX: 303-757-9197	No Revisions:							
	Horiz. Scale: Vert. Scale: As Noted						Revised:	Designer: XXXXXXXX	Structure	XXXXXXXXXXXXXXXX				
	Unit Information Unit Leader Initials							Detailer: XXXXXXXX	Numbers	XXXXXXXXXXXXXXXX				
							Void:	Sheet Subset: WALL	Subset Sheets: WXX of XXX		Sheet Number			
					Staff Bridge Branch		Initials							