B-504-H2

(This sheet must be accompanied with B-504-B1, B2, B3, E1, E2, E3, H3 or H4)

DESIGN CRITERIA:

Note to Designer: Update design for current MASH loads.

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

LS=1.75 — Live Load Surcharge Factor

LLSurg=2' — Live Load Surcharge

dmax=2" — CDOT Class I Backfill Max Size

HMAthk=12" — HMA Thickness

hma=140(Lb/CF) — HMA unit weight

γHMA= max:1.5 min:0.65 — HMA design factor

$Ka=\frac{1-\sin(\phi)}{1+\sin(\phi)}$ — Active Earth Pressure Coefficient Ka

Ko=1-sin(ϕ) — At Rest Earth Pressure Coefficient Ko AASHTO Fig 11.10.6.2.1d-1

Kr(z)= if z≤20', Ko-$\frac{z}{20}$(Ko-Ka), otherwise Ka

For inextensible reinforcement equations listed below Ka shall be replaced with Kr(z), and σv1(z) shall be replaced with Bear(z) for σH(z) computation.

$Rv(z)=\gamma soil \times (\gamma v \times z + LS \times LLSurg) \times RL(z)$ — Resultant of Soil & Surcharge

$Mo(z)=\frac{1}{6} \times Ka \times \gamma h \times \gamma soil \times z^3 + \frac{1}{2} \times Ka \times LS \times \gamma soil \times LLSurg \times z^2$ — Overturning Moment (Use γsoil for HMA)

$Mr(z)=Rv(z) \times RL(z)/2$ — Righting Moment (Use γsoil for HMA)

$ecc(z)=RL(z)/2-[(Mr(z)-Mo(z))/(Rv(z))]$ — Eccentricity of Resultant

$\sigma v1(z)=\gamma v \times \gamma soil \times (z-\frac{HMAthk}{12}) + \gamma HMAmax \times hma \times \frac{HMAthk}{12} + LS \times soil \times LLSurg$ — Overburden with LS

$\sigma v2(z)=\gamma soil \times (z-\frac{HMAthk}{12}) + hma \times \frac{HMAthk}{12}$ — Unfactored Overburden without LS

$\sigma H(z)=Ka \times \sigma v1(z)$ — AASHTO LRFD Eq 11.10.6.2.1-1 (Lb/Ft)

Rail Impact=900 LB/Ft — Per layer Rail Impact with factor of 3

$\sigma h(z)$= if z≤2, $\sigma H(z)$ + Rail Impact otherwise $\sigma h(z)=\sigma H(z)$

$Sum\sigma h(z)= \sigma h(z) \times spacing(z)$ — 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 10.10.6.3.2-1

$Bear(z)=\frac{1}{2} \times \frac{1}{1000} \times \frac{Ry(z)}{RL(z)-2 \times ecc(z)}$ — AASHTO LRFD Eq 11.6.3.2.-1 (Bearing Pressure in TSF)

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 foot of wall.

DH or Z (Ft)	Spacing * (In.)	σH (Lb/Ft)	$\Sigma\sigma$H×spacing ** (Lb/Ft)	Le *** (Ft)
0.667	12	163.268	1009	23.341
1.333	12	198.961	2041	12.394
2.000	NA	230.766	2195	NA
2.667	16	262.571	2370	2.059
3.333	NA	294.377	2567	NA
4.000	24	326.182	2784	2.595
4.667	NA	357.988	3023	NA
5.333	NA	389.793	3283	NA
6.000	NA	421.599	3564	NA
6.667	32	453.404	3866	2.92
7.333	NA	485.209	4189	NA
8.000	NA	517.015	4534	NA
8.667	NA	548.82	4900	NA
9.333	32	580.626	5287	2.685
10.000	NA	612.431	5695	NA
10.667	NA	644.237	6125	NA
11.333	NA	676.042	6576	NA
12.000	28	707.847	7047	2.234
12.667	NA	739.653	7541	NA
13.333	NA	771.458	8055	NA
14.000	24	803.264	8590	1.865
14.667	NA	835.069	9147	NA
15.333	NA	866.875	9725	NA
16.000	24	898.68	10320	1.828
16.667	NA	930.485	10940	NA
17.333	NA	962.291	11590	NA
18.000	24	994.096	12250	1.798
18.667	NA	1.03E+03	12930	NA
19.333	NA	1.06E+03	13640	NA
20.000	24	1.09E+03	14360	1.775
20.667	NA	1.12E+03	15110	NA
21.333	NA	1.15E+03	15880	NA
22.000	24	1.19E+03	16670	1.756
22.667	NA	1.22E+03	17480	NA
23.333	NA	1.25E+03	18310	NA
24.000	24	1.28E+03	19170	1.74
24.667	NA	1.31E+03	20040	NA
25.333	NA	1.34E+03	29400	NA
26.000	24	1.38E+03	21860	1.727
26.667	NA	1.41E+03	22790	NA
27.333	NA	1.44E+03	23750	NA
28.000	20	1.47E+03	24730	1.429
28.667	NA	1.50E+03	25740	NA
29.333	16	1.54E+03	26760	1.139
30.000	NA	1.57E+03	27800	NA
30.667	16	1.60E+03	28870	1.135
31.333	NA	1.63E+03	29960	NA
32.000	16	1.66E+03	31060	1.131
32.667	NA	1.69E+03	32190	NA
33.333	16	1.73E+03	33340	1.127
34.000	NA	1.76E+03	34520	NA
34.667	16	1.79E+03	35710	1.124
35.333	NA	1.82E+03	36920	NA
36.000	12	1.85E+03	38160	0.841
36.667	8	1.89E+03	39410	0.56
37.333	8	1.92E+03	40690	0.559
38.000	8	1.95E+03	41990	0.558
38.667	8	1.98E+03	43310	0.558
39.333	8	2.01E+03	44650	0.557
40.000	4	2.04E+03	46010	0.278

Note: Table is for both extensible and inextensible soil reinforcement, but values are only good for 40' wall. See figure to the right for lower inextensible walls.

* Example spacing

** Summation of σH above Z includes rail impact.

*** Le based on extensible, 0.8xLe for inextensible. Le of top two layers are not developed, layers used for avoiding roadway tension cracks.

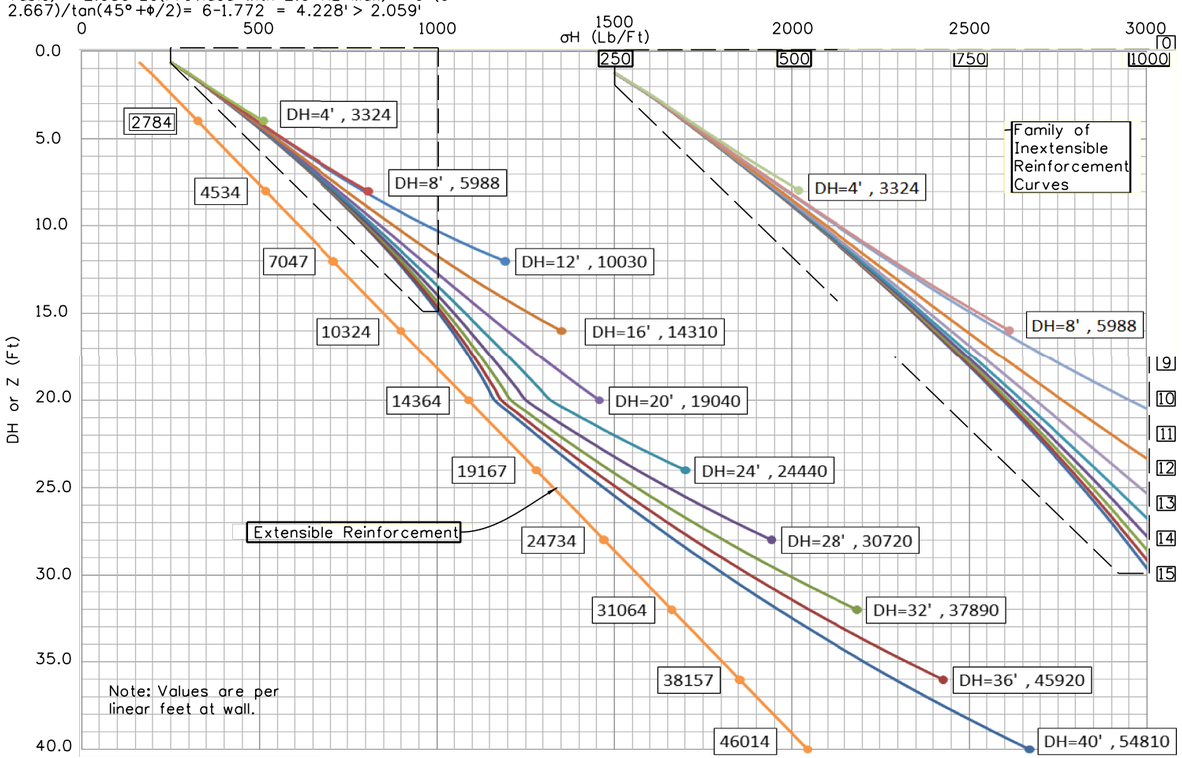
EXAMPLES:

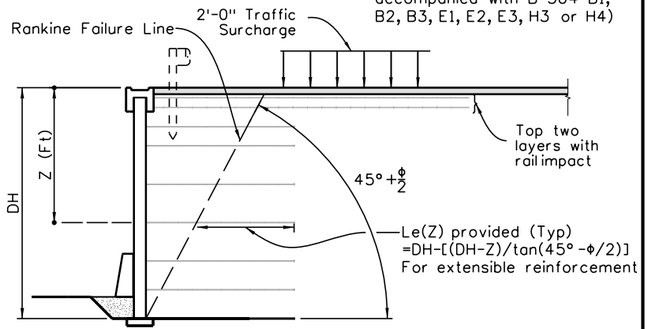
1. Tmax≤T_{al} x R_c — AASHTO 11.10.6.4.1-1
   Geotextile: T_{al}= T_{ult}/RF — AASHTO 11.10.6.4.3b-1
   Steel: T_{al}= AC x FY / b — AASHTO 11.10.6.4.3a-1
   where b=1.969" Ac=.200" — After 75 years loss Ec=0.102"
   $RF=RF_{ID} \times RF_{CR} \times RF_D$
   Where Installation RF_{ID}=1.3
   Durability RF_D=1.1
   RF_{CR}=1.80 for PET & PP — AASHTO 11.10.6.4.3b-2
   RF_{CR}=2.55 for HDPE
   ϕsteel=0.75 vs ϕgeotextile=0.90

2. For DH=10' Check T_{max} at Z=9.333', spacing=32", Rc=1 (For 100% coverage) ϕ=0.9 $T_{max} \le \phi T_{al}$ x R_c (AASHTO 11.10.6.4.1-1)
   a. T_{max} =σH×Spacing=580.626x32/12=1548.336 Lb/Ft ≤ 0.9x7800/(1.3x1.1x2.55) = 1925.134 Lb/Ft
   b. The 10' high wall has 4 HDPE layers 2 PP layers, check sum of all layers. $\Sigma\sigma$H= 1925.134x4 + 1678.32x2 = 11057 Lb/Ft > 5695 Lb/Ft

3. DH=40', Check T_{max} @ z=26' for grid and strip and $\Sigma\sigma$H:
   a. T_{max} = σH×Spacing=1376x24/12=2752≤0.9x12000/(1.3x1.1x2.55) = 2961.74 Lb/Ft
   b. For steel strips: T_{al}=.2x65000/1.969=6602 Lb/STRIP per Ft
   Assuming a 10' wide panel: #ofStrips = 10'x2752 (Lb/Ft)/(0.75x6602) (Lb/STRIP FOOT) requires 6 strips.
   c. For 40' wall check all extensibles. $\Sigma\sigma$Hxspacing; 3x12000(HDPE used at 24',26',28') + 20x7800(HDPE all other layers) + 2x4800(PP for top two layers) = 50744 Lb/Ft > 46010 Lb/Ft

4. Neglect top layer pull out requirement for DH=6' Truncated Base wall on B-504-B3/E3. Check 3rd layer down z=2.667 Le (Required from Table) = 2.059' Le(Provided with 2.0 RL Max) = 6-(6-2.667)/tan(45°+ϕ/2)= 6-1.772 = 4.228' > 2.059'





APPLICATION DIAGRAM (DH=16' AS SHOWN)

5. Factored bearing pressure (BP) for DH=40'
   From B-504-B1 or E1 — BP=4.721 TSF
   From B-504-B2 or E2 — BP=9.596 TSF
   From B-504-B3 or E3 — BP=8.850 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: $DATE$
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Horiz. Scale: Vert. Scale: As Noted
Unit Information Unit Leader Initials

Sheet Revisions

Date:	Comments	Init.

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Initials

As Constructed
No Revisions:
Revised:
Void:

LRFD MSE WALL FOR BLOCK AND PANEL FACING WITH ROADWAY RAIL DESIGN CHARTS/TABLE

Designer: XXXXXXXX
Detailer: XXXXXXXX
Sheet Subset: WALL
Structure Numbers: XXXXXXXXXXXXX
Subset Sheets: WXX of XXX

Project No./Code

Sheet Number

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