Stone Strong
Maximum Gravity Heights
International Building Code

3/16/22

Battered Face

Soil Type / Backfill Slope	Level	Level	3H:1V	Level
Surcharge	0 psf	150 psf	0 psf	0 psf
Seismic PGA	0g	0g	0g	0.20g
Clay, ϕ = 26°	15.0 ft.	12.0 ft.	10.5 ft.	13.5 ft.
Sand, ϕ = 30°	18.0 ft.	15.0 ft.	13.5 ft.	15.0 ft.
Sand/Gravel, ϕ = 34°	21.0 ft.	19.5 ft.	16.5 ft.	16.5 ft.
Crushed Stone, ϕ = 38°	22.5 ft.	21.0 ft.	21.0 ft.	18.0 ft.

Battered Face

Soil Type / Backfill Slope	Level	Level	3H:1V	Level
Surcharge	0 kPa	7.5 kPa	0 kPa	0 kPa
Seismic PGA	0g	0g	0g	0.20g
Clay, ϕ = 26°	4.6 m	3.7 m	3.2 m	4.1 m
Sand, ϕ = 30°	5.5 m	4.6 m	4.1 m	4.6 m
Sand/Gravel, ϕ = 34°	6.4 m	5.9 m	5.0 m	5.0 m
Crushed Stone, ϕ = 38°	6.9 m	6.4 m	6.4 m	5.5 m

The max heights listed are preliminary based on simple boundary conditions and general soil parameters, and should be confirmed or adjusted by a licensed professional engineer based on a site specific analysis

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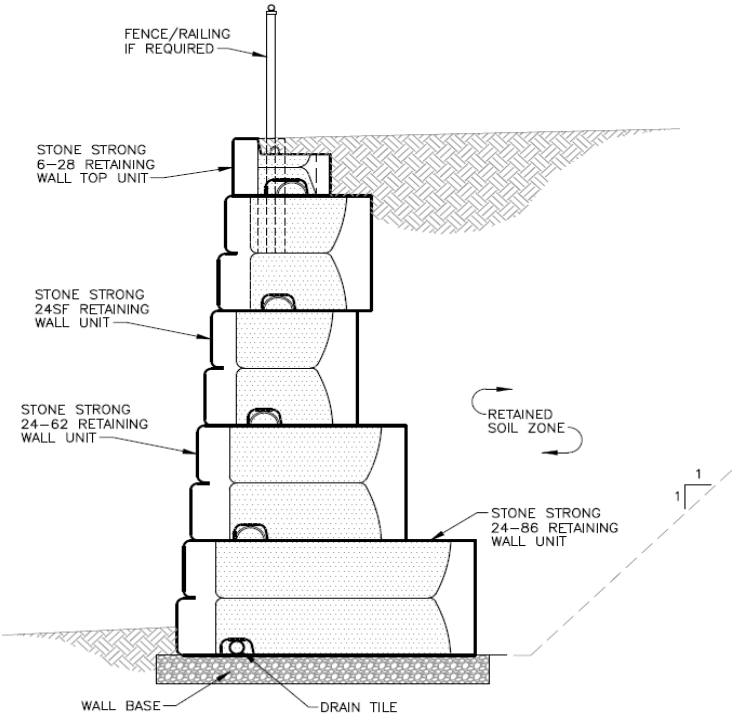
Gravity Design Tables

3/16/22

IBC Load Case 1 - Level Grade, No Surcharge (Battered Face)

Backslope: flat effective grade
Surcharge: None
Standard: International Building Code
Retained Soil: design for weakest soil within zone extending up at 1H:1V slope starting 12 in. behind heel
foundation soil either sand (ϕ=30°) or clay (ϕ=26°, c=100psf)



Configurations shown are preliminary and conceptual, and should not be used without site specific analysis and adjustment by a licensed Professional Engineer

24-86 units may be substituted for 24-62 units
Two 6SF units may be substituted for 24SF units
6SF units may be substituted for 6-28 units

Cohesive Backfill
ϕ=26°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	6.0	7.5	9.0	10.5	12.0	13.5	15.0
5th Course						6-28	24SF
4th Course				6-28	24SF	24SF	24SF
3rd Course		6-28	24SF	24SF	24SF	24SF	24SF
2nd Course	24SF	24SF	24SF	24SF	24SF	24-62	24-86
Bottom Course	24SF	24SF	24SF	24-62	24-62	24-86	24-86

Sand Backfill
ϕ=30°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	9.0	10.5	12.0	13.5	15.0	16.5	18.0
6th Course						6-28	24SF
5th Course				6-28	24SF	24SF	24SF
4th Course		6-28	24SF	24SF	24SF	24SF	24SF
3rd Course	24SF	24SF	24SF	24SF	24SF	24SF	24-62
2nd Course	24SF	24SF	24SF	24SF	24-62	24-62	24-62
Bottom Course	24SF	24SF	24-62	24-62	24-62	24-86	24-86

Gravel Backfill
ϕ=34°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	12.0	13.5	15.0	16.5	18.0	19.5	21.0
7th Course						6-28	24SF
6th Course				6-28	24SF	24SF	24SF
5th Course		6-28	24SF	24SF	24SF	24SF	24SF
4th Course	24SF	24SF	24SF	24SF	24SF	24SF	24SF
3rd Course	24SF	24SF	24SF	24SF	24SF	24-62	24-62
2nd Course	24SF	24SF	24SF	24-62	24-62	24-86	24-86
Bottom Course	24SF	24-62	24-62	24-62	24-86	24-86	24-86

Crushed Stone Backfill
ϕ=38°, c=0psf, γ=125pcf

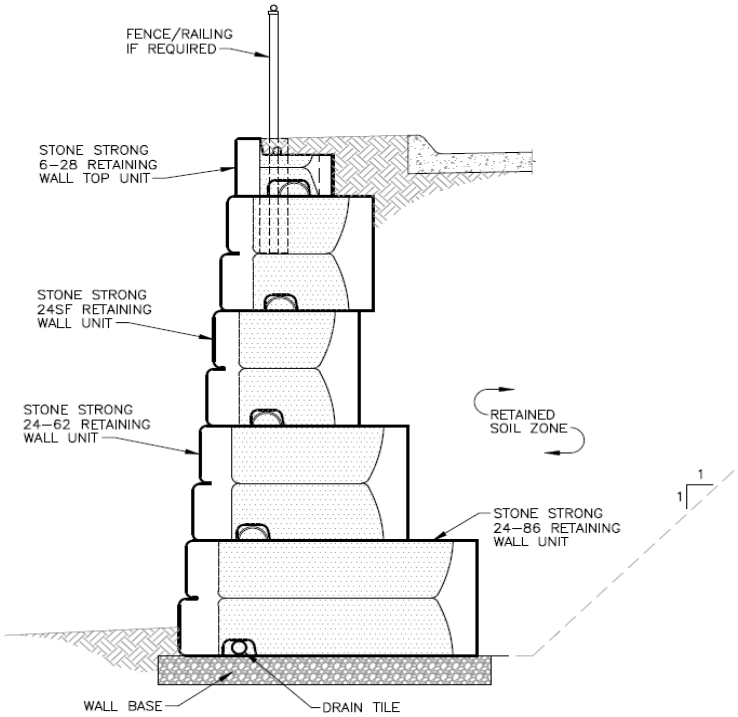
	Total Wall Height (ft)						
	13.5	15.0	16.5	18.0	19.5	21.0	22.5
8th Course							6-28
7th Course					6-28	24SF	24SF
6th Course			6-28	24SF	24SF	24SF	24SF
5th Course	6-28	24SF	24SF	24SF	24SF	24SF	24SF
4th Course	24SF	24SF	24SF	24SF	24SF	24SF	24SF
3rd Course	24SF	24SF	24SF	24SF	24SF	24-62	24-62
2nd Course	24SF	24SF	24SF	24-62	24-62	24-62	24-86
Bottom Course	24SF	24-62	24-62	24-62	24-86	24-86	24-86

Gravity Design Tables

3/16/22

IBC Load Case 2 - Parking Lot Surcharge (Battered Face)

Backslope: flat effective grade
Surcharge: 150 psf (set back 5 ft. from face)
Standard: International Building Code
Retained Soil: design for weakest soil within zone extending up at 1H:1V slope starting 12 in. behind heel
foundation soil either sand (ϕ=30°) or clay (ϕ=26°, c=100psf)



Configurations shown are preliminary and conceptual, and should not be used without site specific analysis and adjustment by a licensed Professional Engineer

24-86 units may be substituted for 24-62 units
Two 6SF units may be substituted for 24SF units
6SF units may be substituted for 6-28 units

Cohesive Backfill
ϕ=26°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	4.5	6.0	7.5	9.0	10.5	12.0	13.5
5th Course							- -
4th Course					6-28	24SF	- -
3rd Course			6-28	24SF	24SF	24SF	- -
2nd Course	6-28	24SF	24SF	24SF	24SF	24-62	- -
Bottom Course	24SF	24SF	24SF	24-62	24-86	24-86	- -

Sand Backfill
ϕ=30°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	6.0	7.5	9.0	10.5	12.0	13.5	15.0
6th Course							
5th Course						6-28	24SF
4th Course				6-28	24SF	24SF	24SF
3rd Course		6-28	24SF	24SF	24SF	24SF	24SF
2nd Course	24SF	24SF	24SF	24SF	24SF	24-62	24-62
Bottom Course	24SF	24SF	24SF	24-62	24-62	24-86	24-86

Gravel Backfill
ϕ=34°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	10.5	12.0	13.5	15.0	16.5	18.0	19.5
7th Course							6-28
6th Course					6-28	24SF	24SF
5th Course			6-28	24SF	24SF	24SF	24SF
4th Course	6-28	24SF	24SF	24SF	24SF	24SF	24SF
3rd Course	24SF	24SF	24SF	24SF	24SF	24-62	24-62
2nd Course	24SF	24SF	24SF	24-62	24-62	24-62	24-86
Bottom Course	24SF	24-62	24-62	24-62	24-86	24-86	24-86

Crushed Stone Backfill
ϕ=38°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	12.0	13.5	15.0	16.5	18.0	19.5	21.0
8th Course							
7th Course						6-28	24SF
6th Course				6-28	24SF	24SF	24SF
5th Course		6-28	24SF	24SF	24SF	24SF	24SF
4th Course	24SF	24SF	24SF	24SF	24SF	24SF	24SF
3rd Course	24SF	24SF	24SF	24SF	24SF	24-62	24-62
2nd Course	24SF	24SF	24SF	24-62	24-62	24-86	24-86
Bottom Course	24SF	24-62	24-62	24-62	24-86	24-86	24-86

Gravity Design Tables

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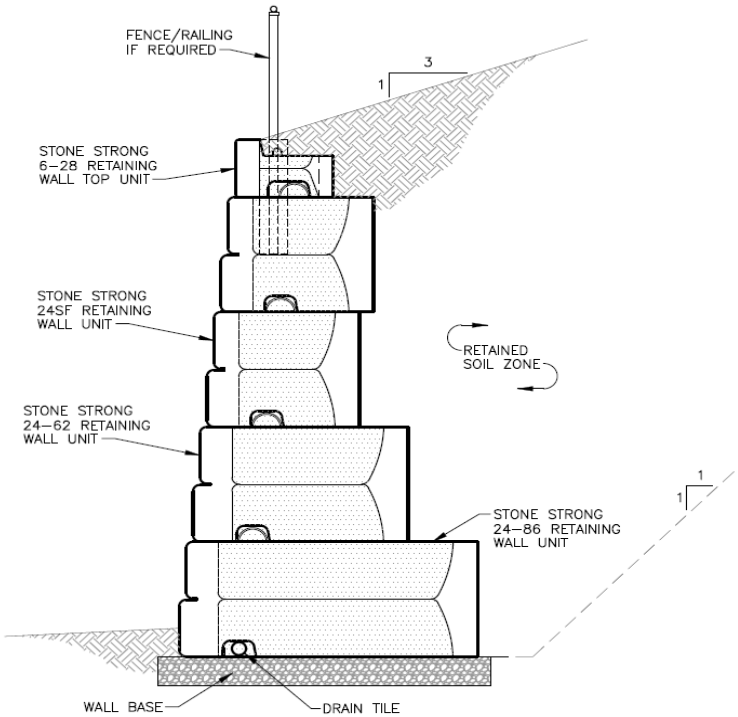
IBC Load Case 3 - Sloping Backfill (Battered Face)

Backslope: 3H:1V grade above wall
Surcharge: None
Standard: International Building Code
Retained Soil: design for weakest soil within zone extending up at 1H:1V slope starting 12 in. behind heel
foundation soil either sand (ϕ=30°) or clay (ϕ=26°, c=100psf)



Configurations shown are preliminary and conceptual, and should not be used without site specific analysis and adjustment by a licensed Professional Engineer

24-86 units may be substituted for 24-62 units
Two 6SF units may be substituted for 24SF units
6SF units may be substituted for 6-28 units

Cohesive Backfill
ϕ=26°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	3.0	4.5	6.0	7.5	9.0	10.5	12.0
5th Course							- -
4th Course						6SF	- -
3rd Course				6-28	24SF	24SF	- -
2nd Course		6-28	24SF	24SF	24SF	24-62	- -
Bottom Course	24SF	24SF	24SF	24-62	24-62	24-86	- -

Sand Backfill
ϕ=30°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	4.5	6.0	7.5	9.0	10.5	12.0	13.5
6th Course							
5th Course							6SF
4th Course					6-28	24SF	24SF
3rd Course			6-28	24SF	24SF	24SF	24SF
2nd Course	6-28	24SF	24SF	24SF	24SF	24SF	24-62
Bottom Course	24SF	24SF	24SF	24SF	24-62	24-86	24-86

Gravel Backfill
ϕ=34°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	7.5	9.0	10.5	12.0	13.5	15.0	16.5
7th Course							
6th Course							6SF
5th Course					6SF	24SF	24SF
4th Course			6-28	24SF	24SF	24SF	24SF
3rd Course	6-28	24SF	24SF	24SF	24SF	24SF	24SF
2nd Course	24SF	24SF	24SF	24SF	24SF	24-62	24-62
Bottom Course	24SF	24SF	24SF	24-62	24-62	24-86	24-86

Crushed Stone Backfill
ϕ=38°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	12.0	13.5	15.0	16.5	18.0	19.5	21.0
8th Course							
7th Course						6-28	24SF
6th Course				6-28	24SF	24SF	24SF
5th Course		6-28	24SF	24SF	24SF	24SF	24SF
4th Course	24SF	24SF	24SF	24SF	24SF	24SF	24SF
3rd Course	24SF	24SF	24SF	24SF	24SF	24-62	24-62
2nd Course	24SF	24SF	24SF	24-62	24-62	24-86	24-86
Bottom Course	24SF	24-62	24-62	24-86	24-86	24-86	24-86

Gravity Design Tables

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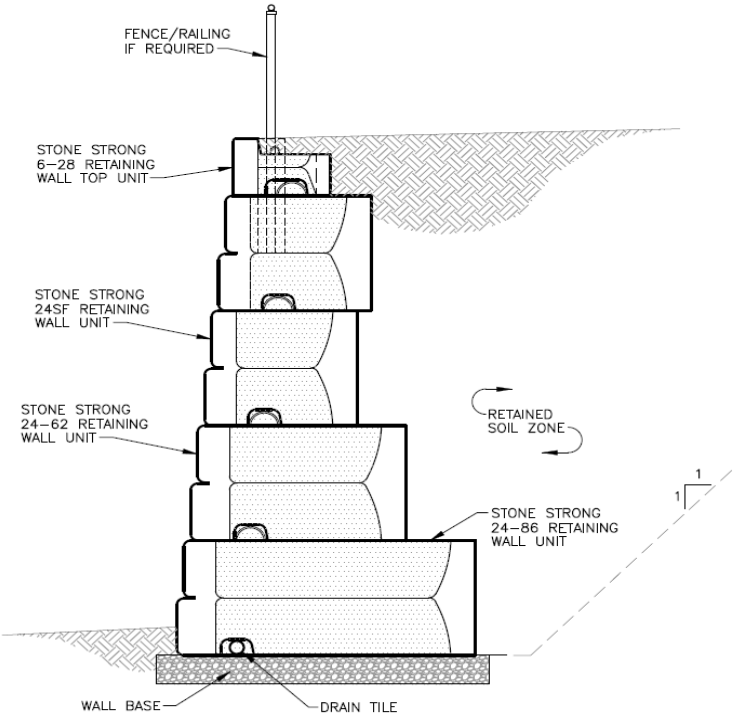
IBC Load Case 4 - Seismic
(Battered Face)

Backslope: flat effective grade
Surcharge: PGA=0.20 (Live Load not concurrent)
Standard: International Building Code
Retained Soil: design for weakest soil within zone extending up at 1H:1V slope starting 12 in. behind heel
foundation soil either sand (ϕ=30°) or clay (ϕ=26°, c=100psf)



Configurations shown are preliminary and conceptual, and should not be used without site specific analysis and adjustment by a licensed Professional Engineer

24-86 units may be substituted for 24-62 units
Two 6SF units may be substituted for 24SF units
6SF units may be substituted for 6-28 units

Cohesive Backfill
ϕ=26°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	4.5	6.0	7.5	9.0	10.5	12.0	13.5
5th Course							6-28
4th Course					6-28	24SF	24SF
3rd Course			6-28	24SF	24SF	24SF	24SF
2nd Course	6-28	24SF	24SF	24SF	24SF	24-62	24-62
Bottom Course	24SF	24SF	24SF	24-62	24-62	24-86	24-86

Sand Backfill
ϕ=30°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	6.0	7.5	9.0	10.5	12.0	13.5	15.0
6th Course							
5th Course						6-28	24SF
4th Course				6-28	24SF	24SF	24SF
3rd Course		6-28	24SF	24SF	24SF	24SF	24SF
2nd Course	24SF	24SF	24SF	24SF	24SF	24-62	24-62
Bottom Course	24SF	24SF	24SF	24-62	24-62	24-86	24-86

Gravel Backfill
ϕ=34°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	7.5	9.0	10.5	12.0	13.5	15.0	16.5
7th Course							
6th Course							6-28
5th Course					6-28	24SF	24SF
4th Course			6-28	24SF	24SF	24SF	24SF
3rd Course	6-28	24SF	24SF	24SF	24SF	24SF	24SF
2nd Course	24SF	24SF	24SF	24SF	24SF	24-62	24-62
Bottom Course	24SF	24SF	24SF	24-62	24-86	24-86	24-86

Crushed Stone Backfill
ϕ=38°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	9.0	10.5	12.0	13.5	15.0	16.5	18.0
8th Course							
7th Course							
6th Course						6-28	24SF
5th Course				6-28	24SF	24SF	24SF
4th Course		6-28	24SF	24SF	24SF	24SF	24SF
3rd Course	24SF	24SF	24SF	24SF	24SF	24SF	24-62
2nd Course	24SF	24SF	24SF	24SF	24-62	24-62	24-86
Bottom Course	24SF	24SF	24-62	24-62	24-86	24-86	24-86

Gravity Design Tables

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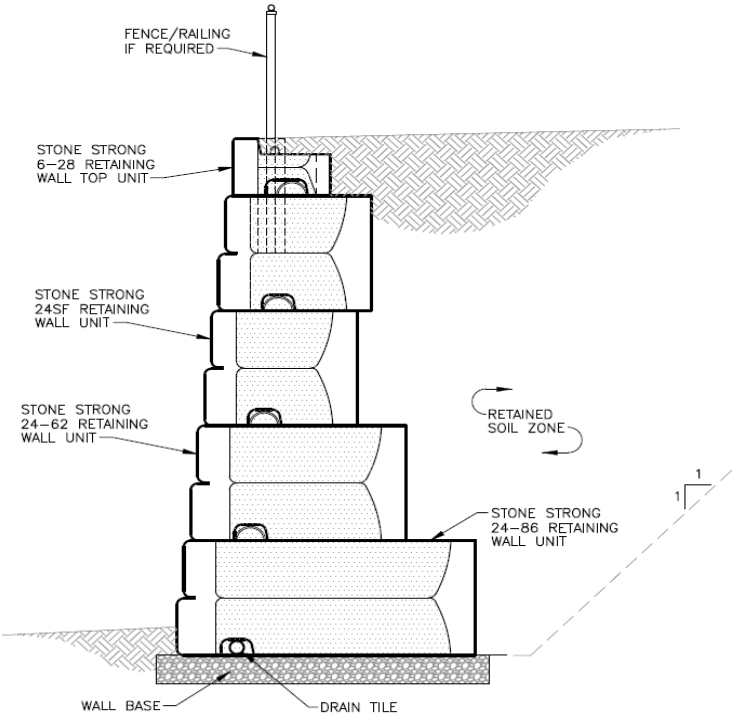
IBC Load Case 1 - Level Grade, No Surcharge (Battered Face)

Backslope: flat effective grade
Surcharge: None
Standard: International Building Code
Retained Soil: design for weakest soil within zone extending up at 1H:1V slope starting 300 mm behind heel
foundation soil either sand (ϕ=30°) or clay (ϕ=26°, c=5 kPa)



Configurations shown are preliminary and conceptual, and should not be used without site specific analysis and adjustment by a licensed Professional Engineer

24-86 units may be substituted for 24-62 units
Two 6SF units may be substituted for 24SF units
6SF units may be substituted for 6-28 units

Cohesive Backfill
ϕ=26°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	1.8	**2.3**	**2.7**	**3.2**	**3.7**	**4.1**	**4.6**
5th Course						6-28	24SF
4th Course				6-28	24SF	24SF	24SF
3rd Course		6-28	24SF	24SF	24SF	24SF	24SF
2nd Course	24SF	24SF	24SF	24SF	24SF	24-62	24-86
Bottom Course	24SF	24SF	24SF	24-62	24-62	24-86	24-86

Sand Backfill
ϕ=30°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	2.7	**3.2**	**3.7**	**4.1**	**4.6**	**5.0**	**5.5**
6th Course						6-28	24SF
5th Course				6-28	24SF	24SF	24SF
4th Course		6-28	24SF	24SF	24SF	24SF	24SF
3rd Course	24SF	24SF	24SF	24SF	24SF	24SF	24-62
2nd Course	24SF	24SF	24SF	24SF	24-62	24-62	24-62
Bottom Course	24SF	24SF	24-62	24-62	24-62	24-86	24-86

Gravel Backfill
ϕ=34°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	3.7	**4.1**	**4.6**	**5.0**	**5.5**	**5.9**	**6.4**
7th Course						6-28	24SF
6th Course				6-28	24SF	24SF	24SF
5th Course		6-28	24SF	24SF	24SF	24SF	24SF
4th Course	24SF	24SF	24SF	24SF	24SF	24SF	24SF
3rd Course	24SF	24SF	24SF	24SF	24SF	24-62	24-62
2nd Course	24SF	24SF	24SF	24-62	24-62	24-86	24-86
Bottom Course	24SF	24-62	24-62	24-62	24-86	24-86	24-86

Crushed Stone Backfill
ϕ=38°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	4.1	**4.6**	**5.0**	**5.5**	**5.9**	**6.4**	**6.9**
8th Course							6-28
7th Course					6-28	24SF	24SF
6th Course			6-28	24SF	24SF	24SF	24SF
5th Course	6-28	24SF	24SF	24SF	24SF	24SF	24SF
4th Course	24SF	24SF	24SF	24SF	24SF	24SF	24SF
3rd Course	24SF	24SF	24SF	24SF	24SF	24-62	24-62
2nd Course	24SF	24SF	24SF	24-62	24-62	24-62	24-86
Bottom Course	24SF	24-62	24-62	24-62	24-86	24-86	24-86

Gravity Design Tables

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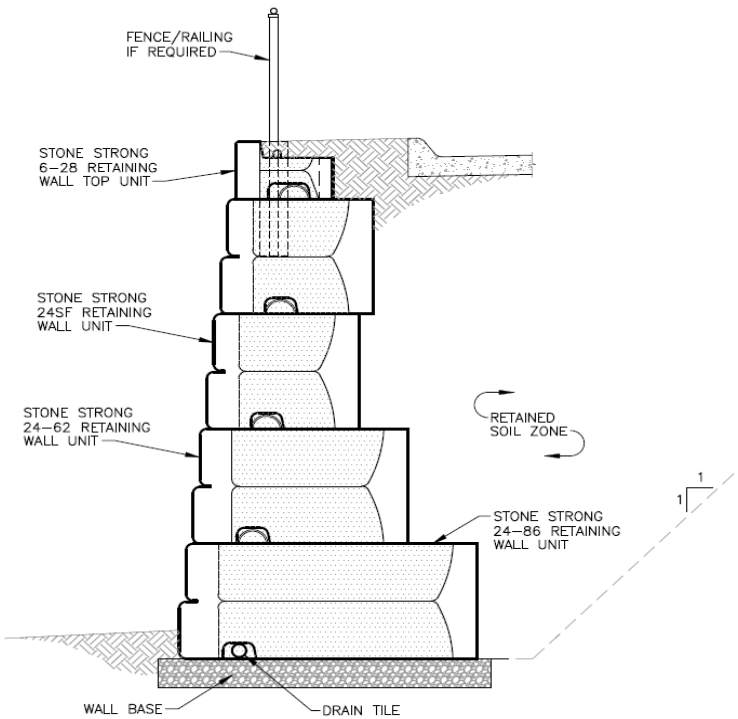
IBC Load Case 2 - Parking Lot Surcharge (Battered Face)

Backslope: flat effective grade
Surcharge: 7.5 kPa (set back 1.5 m from face)
Standard: International Building Code
Retained Soil: design for weakest soil within zone extending up at 1H:1V slope starting 300 mm behind heel
foundation soil either sand (ϕ=30°) or clay (ϕ=26°, c=5 kPa)



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24-86 units may be substituted for 24-62 units
Two 6SF units may be substituted for 24SF units
6SF units may be substituted for 6-28 units

Cohesive Backfill
ϕ=26°, c=5kPa, γ=20kN/m^3

	Total Wall Height (m)						
	1.4	1.8	2.3	2.7	3.2	3.7	4.1
5th Course							- -
4th Course					6-28	24SF	- -
3rd Course			6-28	24SF	24SF	24SF	- -
2nd Course	6-28	24SF	24SF	24SF	24SF	24-62	- -
Bottom Course	24SF	24SF	24SF	24-62	24-86	24-86	- -

Sand Backfill
ϕ=30°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	1.8	2.3	2.7	3.2	3.7	4.1	4.6
6th Course							
5th Course						6-28	24SF
4th Course				6-28	24SF	24SF	24SF
3rd Course		6-28	24SF	24SF	24SF	24SF	24SF
2nd Course	24SF	24SF	24SF	24SF	24SF	24-62	24-62
Bottom Course	24SF	24SF	24SF	24-62	24-62	24-86	24-86

Gravel Backfill
ϕ=34°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	3.2	3.7	4.1	4.6	5.0	5.5	5.9
7th Course							6-28
6th Course					6-28	24SF	24SF
5th Course			6-28	24SF	24SF	24SF	24SF
4th Course	6-28	24SF	24SF	24SF	24SF	24SF	24SF
3rd Course	24SF	24SF	24SF	24SF	24SF	24-62	24-62
2nd Course	24SF	24SF	24SF	24-62	24-62	24-62	24-86
Bottom Course	24SF	24-62	24-62	24-62	24-86	24-86	24-86

Crushed Stone Backfill
ϕ=38°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	3.7	4.1	4.6	5.0	5.5	5.9	6.4
8th Course							
7th Course						6-28	24SF
6th Course				6-28	24SF	24SF	24SF
5th Course		6-28	24SF	24SF	24SF	24SF	24SF
4th Course	24SF	24SF	24SF	24SF	24SF	24SF	24SF
3rd Course	24SF	24SF	24SF	24SF	24SF	24-62	24-62
2nd Course	24SF	24SF	24SF	24-62	24-62	24-86	24-86
Bottom Course	24SF	24-62	24-62	24-62	24-86	24-86	24-86

Gravity Design Tables

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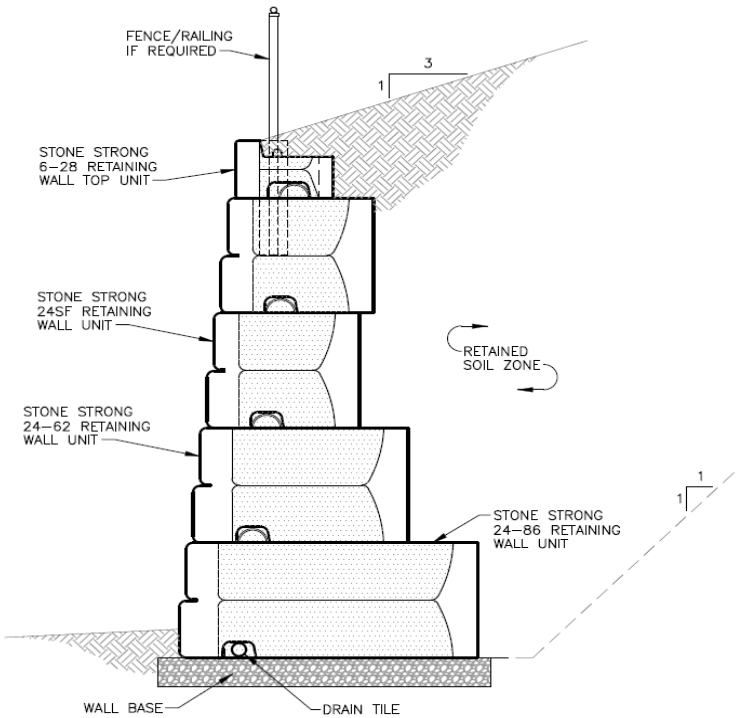
IBC Load Case 3 - Sloping Backfill (Battered Face)

Backslope: 3H:1V grade above wall
Surcharge: None
Standard: International Building Code
Retained Soil: design for weakest soil within zone extending up at 1H:1V slope starting 300 mm behind heel
foundation soil either sand (ϕ=30°) or clay (ϕ=26°, c=5 kPa)



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24-86 units may be substituted for 24-62 units
Two 6SF units may be substituted for 24SF units
6SF units may be substituted for 6-28 units

Cohesive Backfill
ϕ=26°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	0.9	1.4	1.8	2.3	2.7	3.2	3.7
5th Course							- -
4th Course						6SF	- -
3rd Course				6-28	24SF	24SF	- -
2nd Course		6-28	24SF	24SF	24SF	24-62	- -
Bottom Course	24SF	24SF	24SF	24-62	24-62	24-86	- -

Sand Backfill
ϕ=30°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	1.4	1.8	2.3	2.7	3.2	3.7	4.1
6th Course							
5th Course							6SF
4th Course					6-28	24SF	24SF
3rd Course			6-28	24SF	24SF	24SF	24SF
2nd Course	6-28	24SF	24SF	24SF	24SF	24SF	24-62
Bottom Course	24SF	24SF	24SF	24SF	24-62	24-86	24-86

Gravel Backfill
ϕ=34°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	2.3	2.7	3.2	3.7	4.1	4.6	5.0
7th Course							
6th Course							6SF
5th Course					6SF	24SF	24SF
4th Course			6-28	24SF	24SF	24SF	24SF
3rd Course	6-28	24SF	24SF	24SF	24SF	24SF	24SF
2nd Course	24SF	24SF	24SF	24SF	24SF	24-62	24-62
Bottom Course	24SF	24SF	24SF	24-62	24-62	24-86	24-86

Crushed Stone Backfill
ϕ=38°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	3.7	4.1	4.6	5.0	5.5	5.9	6.4
8th Course							
7th Course						6-28	24SF
6th Course				6-28	24SF	24SF	24SF
5th Course		6-28	24SF	24SF	24SF	24SF	24SF
4th Course	24SF	24SF	24SF	24SF	24SF	24SF	24SF
3rd Course	24SF	24SF	24SF	24SF	24SF	24-62	24-62
2nd Course	24SF	24SF	24SF	24-62	24-62	24-86	24-86
Bottom Course	24SF	24-62	24-62	24-86	24-86	24-86	24-86

Gravity Design Tables

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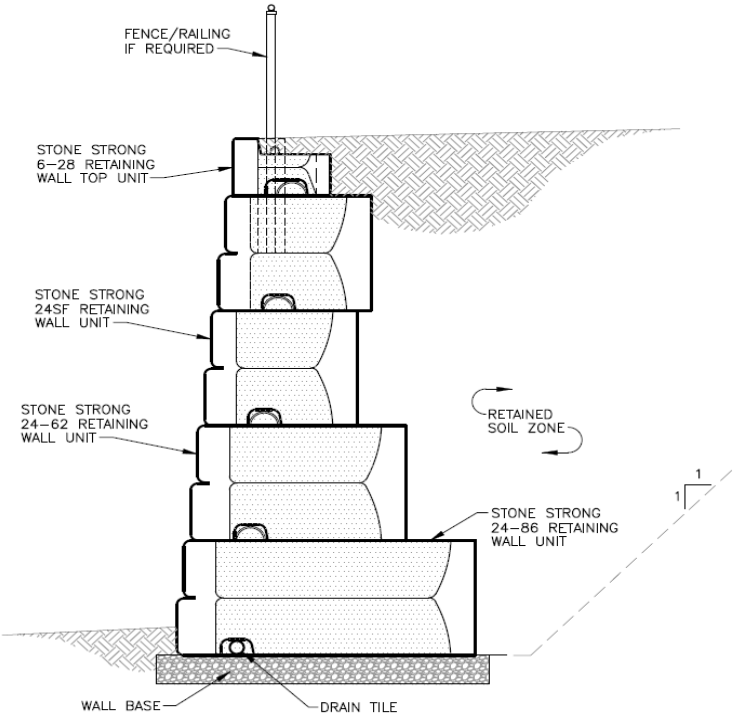
IBC Load Case 4 - Seismic
(Battered Face)

Backslope: flat effective grade
Surcharge: PGA=0.20 (Live Load not concurrent)
Standard: International Building Code
Retained Soil: design for weakest soil within zone extending up at 1H:1V slope starting 300 mm behind heel
foundation soil either sand (ϕ=30°) or clay (ϕ=26°, c=5 kPa)



Configurations shown are preliminary and conceptual, and should not be used without site specific analysis and adjustment by a licensed Professional Engineer

24-86 units may be substituted for 24-62 units
Two 6SF units may be substituted for 24SF units
6SF units may be substituted for 6-28 units

Cohesive Backfill
ϕ=26°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	1.4	1.8	2.3	2.7	3.2	3.7	4.1
5th Course							6-28
4th Course					6-28	24SF	24SF
3rd Course			6-28	24SF	24SF	24SF	24SF
2nd Course	6-28	24SF	24SF	24SF	24SF	24-62	24-62
Bottom Course	24SF	24SF	24SF	24-62	24-62	24-86	24-86

Sand Backfill
ϕ=30°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	1.8	2.3	2.7	3.2	3.7	4.1	4.6
6th Course							
5th Course						6-28	24SF
4th Course				6-28	24SF	24SF	24SF
3rd Course		6-28	24SF	24SF	24SF	24SF	24SF
2nd Course	24SF	24SF	24SF	24SF	24SF	24-62	24-62
Bottom Course	24SF	24SF	24SF	24-62	24-62	24-86	24-86

Gravel Backfill
ϕ=34°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	2.3	2.7	3.2	3.7	4.1	4.6	5.0
7th Course							
6th Course							6-28
5th Course					6-28	24SF	24SF
4th Course			6-28	24SF	24SF	24SF	24SF
3rd Course	6-28	24SF	24SF	24SF	24SF	24SF	24SF
2nd Course	24SF	24SF	24SF	24SF	24SF	24-62	24-62
Bottom Course	24SF	24SF	24SF	24-62	24-86	24-86	24-86

Crushed Stone Backfill
ϕ=38°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	2.7	3.2	3.7	4.1	4.6	5.0	5.5
8th Course							
7th Course							
6th Course						6-28	24SF
5th Course				6-28	24SF	24SF	24SF
4th Course		6-28	24SF	24SF	24SF	24SF	24SF
3rd Course	24SF	24SF	24SF	24SF	24SF	24SF	24-62
2nd Course	24SF	24SF	24SF	24SF	24-62	24-62	24-86
Bottom Course	24SF	24SF	24-62	24-62	24-86	24-86	24-86

Stone Strong
Maximum Gravity Heights
AASHTO/CHBDC LRFD

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AASHTO LRFD - Battered Face

Soil Type / Backfill Slope	Level	Level	3H:1V	Level
Surcharge	0 psf	250 psf	0 psf	0 psf
Seismic PGA	0g	0g	0g	0.20g
Clay, ϕ = 26°	13.5 ft.	10.5 ft.	10.5 ft.	13.5 ft.
Sand, ϕ = 30°	16.5 ft.	13.5 ft.	13.5 ft.	16.5 ft.
Sand/Gravel, ϕ = 34°	18.0 ft.	15.0 ft.	16.5 ft.	18.0 ft.
Crushed Stone, ϕ = 38°	19.5 ft.	16.5 ft.	18.0 ft.	19.5 ft.

AASHTO LRFD - Vertical Face

Soil Type / Backfill Slope	Level	Level	3H:1V	Level
Surcharge	0 psf	250 psf	0 psf	0 psf
Seismic PGA	0g	0g	0g	0.20g
Clay, ϕ = 26°	13.5 ft.	10.5 ft.	10.5 ft.	13.5 ft.
Sand, ϕ = 30°	15.0 ft.	13.5 ft.	13.5 ft.	15.0 ft.
Sand/Gravel, ϕ = 34°	16.5 ft.	13.5 ft.	15.0 ft.	16.5 ft.
Crushed Stone, ϕ = 38°	16.5 ft.	15.0 ft.	16.5 ft.	16.5 ft.

CHBDC LRFD - Battered Face

Soil Type / Backfill Slope	Level	Level	3H:1V	Level
Surcharge	0 kPa	16 kPa	0 kPa	0 kPa
Seismic PGA	0g	0g	0g	0.20g
Clay, ϕ = 26°	4.1 m	2.7 m	2.7 m	4.1 m
Sand, ϕ = 30°	5.0 m	3.2 m	3.7 m	4.6 m
Sand/Gravel, ϕ = 34°	5.5 m	4.1 m	4.6 m	5.0 m
Crushed Stone, ϕ = 38°	5.9 m	5.0 m	5.5 m	5.5 m

CHBDC LRFD - Vertical Face

Soil Type / Backfill Slope	Level	Level	3H:1V	Level
Surcharge	0 kPa	16 kPa	0 kPa	0 kPa
Seismic PGA	0g	0g	0g	0.20g
Clay, ϕ = 26°	4.1 m	2.7 m	3.2 m	4.1 m
Sand, ϕ = 30°	4.6 m	3.7 m	3.7 m	4.6 m
Sand/Gravel, ϕ = 34°	5.0 m	4.1 m	4.6 m	4.6 m
Crushed Stone, ϕ = 38°	5.5 m	4.6 m	5.0 m	5.0 m

The max heights listed are preliminary based on simple boundary conditions and general soil parameters, and should be confirmed or adjusted by a licensed professional engineer based on a site specific analysis

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Gravity Design Tables

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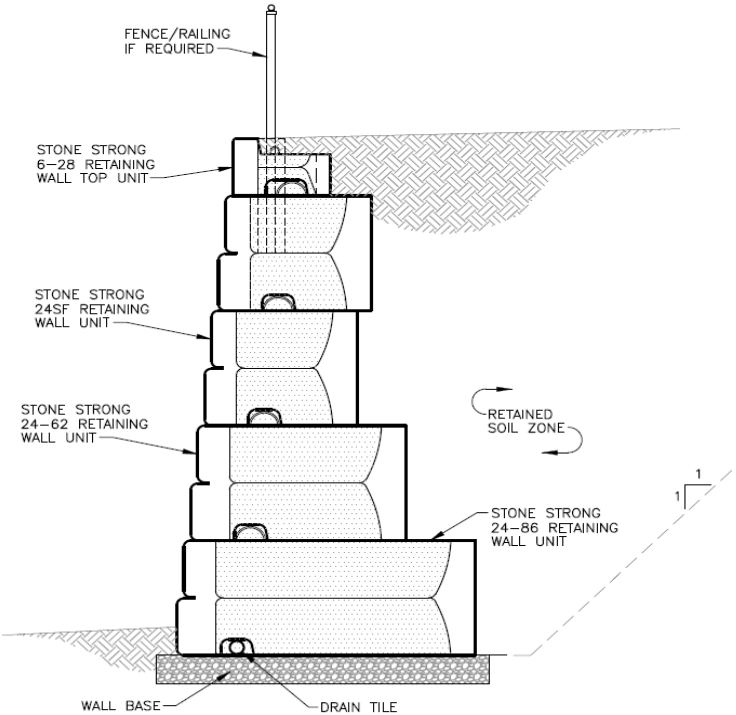
AASHTO Load Case 1 - Level Grade, No Surcharge (Battered Face)

Backslope: flat effective grade
Surcharge: None
Standard: AASHTO LRFD Bridge Design Specifications
Retained Soil: design for weakest soil within zone extending up at 1H:1V slope starting 12 in. behind heel
foundation soil either sand (ϕ=30°) or clay (ϕ=26°, c=100psf)



Configurations shown are preliminary and conceptual, and should not be used without site specific analysis and adjustment by a licensed Professional Engineer

24-86 units may be substituted for 24-62 units
Two 6SF units may be substituted for 24SF units
6SF units may be substituted for 6-28 units

Cohesive Backfill
ϕ=26°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	6.0	7.5	9.0	10.5	12.0	13.5	15.0
5th Course						6-28	- -
4th Course				6-28	24SF	24SF	- -
3rd Course		6-28	24SF	24SF	24SF	24SF	- -
2nd Course	24SF	24SF	24SF	24SF	24-62	24-62	- -
Bottom Course	24SF	24SF	24-62	24-62	24-86	24-86	- -

Sand Backfill
ϕ=30°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	7.5	9.0	10.5	12.0	13.5	15.0	16.5
6th Course							6SF
5th Course					6-28	24SF	24SF
4th Course			6-28	24SF	24SF	24SF	24SF
3rd Course	6-28	24SF	24SF	24SF	24SF	24SF	24SF
2nd Course	24SF	24SF	24SF	24SF	24SF	24-62	24-62
Bottom Course	24SF	24SF	24-62	24-62	24-86	24-86	24-86

Gravel Backfill
ϕ=34°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	9.0	10.5	12.0	13.5	15.0	16.5	18.0
7th Course							
6th Course						6-28	24SF
5th Course				6-28	24SF	24SF	24SF
4th Course		6-28	24SF	24SF	24SF	24SF	24SF
3rd Course	24SF	24SF	24SF	24SF	24SF	24SF	24SF
2nd Course	24SF	24SF	24SF	24SF	24SF	24-62	24-62
Bottom Course	24SF	24SF	24-62	24-62	24-86	24-86	24-86

Crushed Stone Backfill
ϕ=38°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	10.5	12.0	13.5	15.0	16.5	18.0	19.5
8th Course							
7th Course							6SF
6th Course					6-28	24SF	24SF
5th Course			6-28	24SF	24SF	24SF	24SF
4th Course	6-28	24SF	24SF	24SF	24SF	24SF	24SF
3rd Course	24SF	24SF	24SF	24SF	24SF	24SF	24SF
2nd Course	24SF	24SF	24SF	24SF	24SF	24-62	24-62
Bottom Course	24SF	24SF	24-62	24-62	24-86	24-86	24-86

Gravity Design Tables

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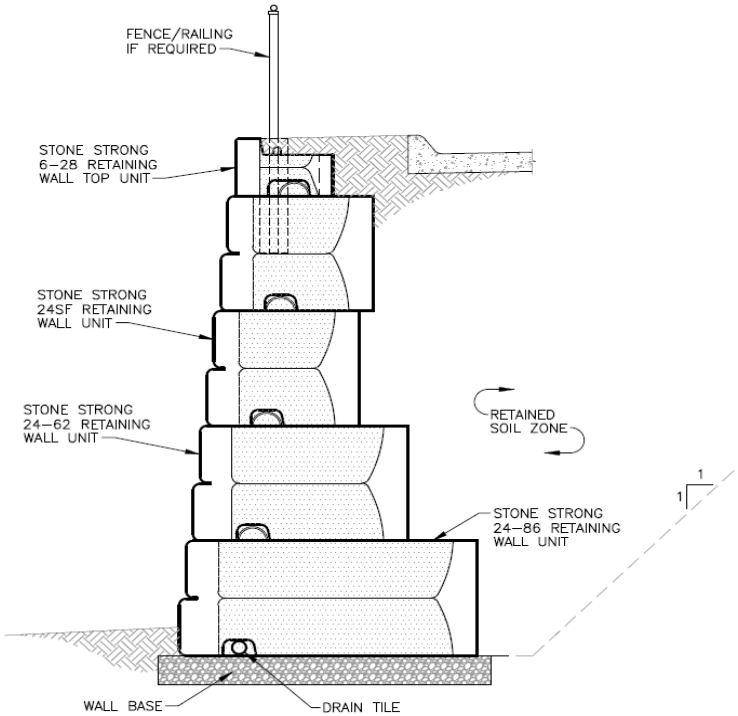
AASHTO Load Case 2 - Highway Surcharge (Battered Face)

Backslope: flat effective grade
Surcharge: 250 psf (set back 5 ft. from face)
Standard: AASHTO LRFD Bridge Design Specifications
Retained Soil: design for weakest soil within zone extending up at 1H:1V slope starting 12 in. behind heel
foundation soil either sand (ϕ=30°) or clay (ϕ=26°, c=100psf)



Configurations shown are preliminary and conceptual, and should not be used without site specific analysis and adjustment by a licensed Professional Engineer

24-86 units may be substituted for 24-62 units
Two 6SF units may be substituted for 24SF units
6SF units may be substituted for 6-28 units

Cohesive Backfill
ϕ=26°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	3.0	4.5	6.0	7.5	9.0	10.5	12.0
5th Course							- -
4th Course						6-28	- -
3rd Course				6-28	24SF	24SF	- -
2nd Course		6-28	24SF	24SF	24SF	24SF	- -
Bottom Course	24SF	24SF	24-62	24-62	24-86	24-86	- -

Sand Backfill
ϕ=30°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	4.5	6.0	7.5	9.0	10.5	12.0	13.5
6th Course							
5th Course							6-28
4th Course					6-28	24SF	24SF
3rd Course			6-28	24SF	24SF	24SF	24SF
2nd Course	6-28	24SF	24SF	24SF	24SF	24-62	24-62
Bottom Course	24SF	24SF	24SF	24-62	24-86	24-86	24-86

Gravel Backfill
ϕ=34°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	6.0	7.5	9.0	10.5	12.0	13.5	15.0
7th Course							
6th Course							
5th Course						6-28	24SF
4th Course				6-28	24SF	24SF	24SF
3rd Course		6-28	24SF	24SF	24SF	24SF	24-62
2nd Course	24SF	24SF	24SF	24SF	24-62	24-62	24-62
Bottom Course	24SF	24SF	24-62	24-62	24-86	24-86	24-86

Crushed Stone Backfill
ϕ=38°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	7.5	9.0	10.5	12.0	13.5	15.0	16.5
8th Course							
7th Course							
6th Course							6-28
5th Course					6-28	24SF	24SF
4th Course			6-28	24SF	24SF	24SF	24SF
3rd Course	6-28	24SF	24SF	24SF	24SF	24SF	24SF
2nd Course	24SF	24SF	24SF	24SF	24SF	24-62	24-62
Bottom Course	24SF	24SF	24SF	24-62	24-86	24-86	24-86

Gravity Design Tables

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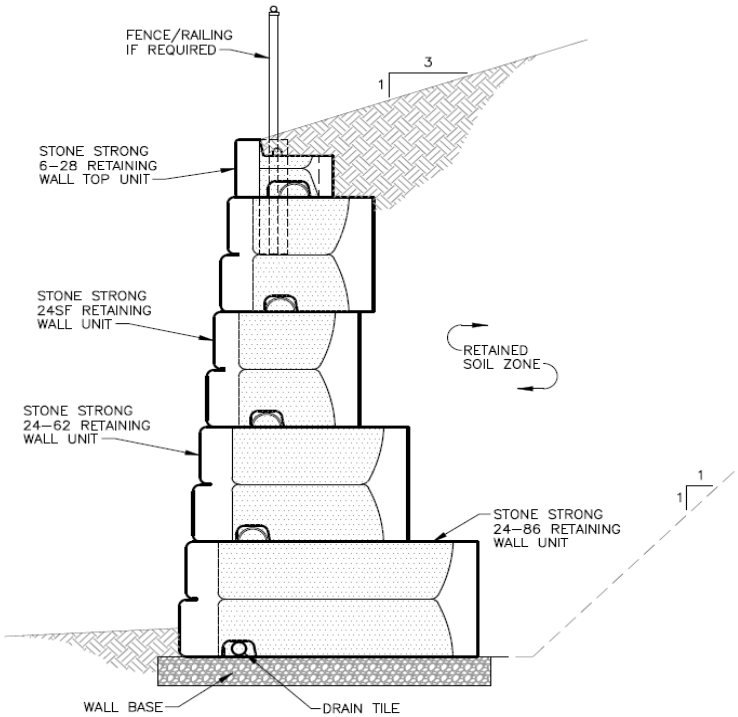
AASHTO Load Case 3 - Sloping Backfill
(Battered Face)

Backslope: 3H:1V grade above wall
Surcharge: None
Standard: AASHTO LRFD Bridge Design Specifications
Retained Soil: design for weakest soil within zone extending up at 1H:1V slope starting 12 in. behind heel
foundation soil either sand (ϕ=30°) or clay (ϕ=26°, c=100psf)



Configurations shown are preliminary and conceptual, and should not be used without site specific analysis and adjustment by a licensed Professional Engineer

24-86 units may be substituted for 24-62 units
Two 6SF units may be substituted for 24SF units
6SF units may be substituted for 6-28 units

Cohesive Backfill
ϕ=26°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	3.0	4.5	6.0	7.5	9.0	10.5	12.0
5th Course							- -
4th Course						6-28	- -
3rd Course				6-28	24SF	24SF	- -
2nd Course		6-28	24SF	24SF	24SF	24-86	- -
Bottom Course	24SF	24SF	24SF	24-62	24-86	24-86	- -

Sand Backfill
ϕ=30°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	4.5	6.0	7.5	9.0	10.5	12.0	13.5
6th Course							
5th Course							6-28
4th Course					6SF	24SF	24SF
3rd Course			6-28	24SF	24SF	24SF	24SF
2nd Course	6-28	24SF	24SF	24SF	24SF	24-62	24-86
Bottom Course	24SF	24SF	24SF	24-62	24-62	24-86	24-86

Gravel Backfill
ϕ=34°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	7.5	9.0	10.5	12.0	13.5	15.0	16.5
7th Course							
6th Course							6SF
5th Course					6SF	24SF	24SF
4th Course			6-28	24SF	24SF	24SF	24SF
3rd Course	6-28	24SF	24SF	24SF	24SF	24SF	24SF
2nd Course	24SF	24SF	24SF	24SF	24-62	24-62	24-62
Bottom Course	24SF	24SF	24-62	24-62	24-62	24-86	24-86

Crushed Stone Backfill
ϕ=38°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	9.0	10.5	12.0	13.5	15.0	16.5	18.0
8th Course							
7th Course							
6th Course						6-28	24SF
5th Course				6-28	24SF	24SF	24SF
4th Course		6-28	24SF	24SF	24SF	24SF	24SF
3rd Course	24SF	24SF	24SF	24SF	24SF	24SF	24SF
2nd Course	24SF	24SF	24SF	24SF	24SF	24-62	24-62
Bottom Course	24SF	24SF	24-62	24-62	24-86	24-86	24-86

Gravity Design Tables

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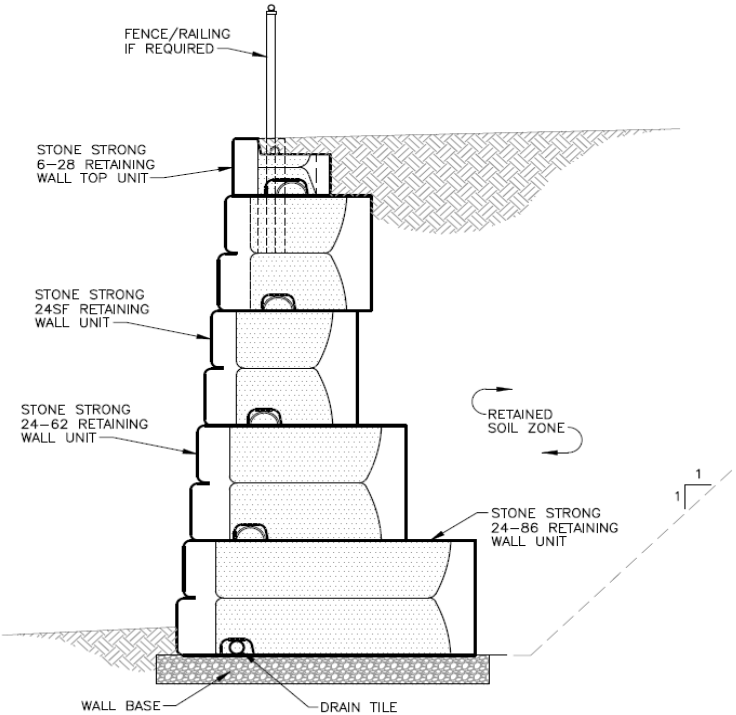
AASHTO Load Case 4 - Seismic
(Battered Face)

Backslope: flat effective grade
Surcharge: PGA=0.20 (Live Load not concurrent)
Standard: AASHTO LRFD Bridge Design Specifications
Retained Soil: design for weakest soil within zone extending up at 1H:1V slope starting 12 in. behind heel
foundation soil either sand (ϕ=30°) or clay (ϕ=26°, c=100psf)



Configurations shown are preliminary and conceptual, and should not be used without site specific analysis and adjustment by a licensed Professional Engineer

24-86 units may be substituted for 24-62 units
Two 6SF units may be substituted for 24SF units
6SF units may be substituted for 6-28 units

Cohesive Backfill
ϕ=26°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	6.0	7.5	9.0	10.5	12.0	13.5	15.0
5th Course						6-28	- -
4th Course				6-28	24SF	24SF	- -
3rd Course		6-28	24SF	24SF	24SF	24SF	- -
2nd Course	24SF	24SF	24SF	24SF	24-62	24-62	- -
Bottom Course	24SF	24SF	24-62	24-62	24-86	24-86	- -

Sand Backfill
ϕ=30°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	7.5	9.0	10.5	12.0	13.5	15.0	16.5
6th Course							6SF
5th Course					6-28	24SF	24SF
4th Course			6-28	24SF	24SF	24SF	24SF
3rd Course	6-28	24SF	24SF	24SF	24SF	24SF	24-62
2nd Course	24SF	24SF	24SF	24SF	24-62	24-62	24-62
Bottom Course	24SF	24SF	24-62	24-62	24-86	24-86	24-86

Gravel Backfill
ϕ=34°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	9.0	10.5	12.0	13.5	15.0	16.5	18.0
7th Course							
6th Course						6-28	24SF
5th Course				6-28	24SF	24SF	24SF
4th Course		6-28	24SF	24SF	24SF	24SF	24SF
3rd Course	24SF	24SF	24SF	24SF	24SF	24SF	24-62
2nd Course	24SF	24SF	24SF	24SF	24-62	24-62	24-62
Bottom Course	24SF	24SF	24-62	24-62	24-62	24-86	24-86

Crushed Stone Backfill
ϕ=38°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	10.5	12.0	13.5	15.0	16.5	18.0	19.5
8th Course							
7th Course							6-28
6th Course					6-28	24SF	24SF
5th Course			6-28	24SF	24SF	24SF	24SF
4th Course	6-28	24SF	24SF	24SF	24SF	24SF	24SF
3rd Course	24SF	24SF	24SF	24SF	24SF	24SF	24-62
2nd Course	24SF	24SF	24SF	24SF	24-62	24-62	24-86
Bottom Course	24SF	24SF	24-62	24-62	24-86	24-86	24-86

Gravity Design Tables

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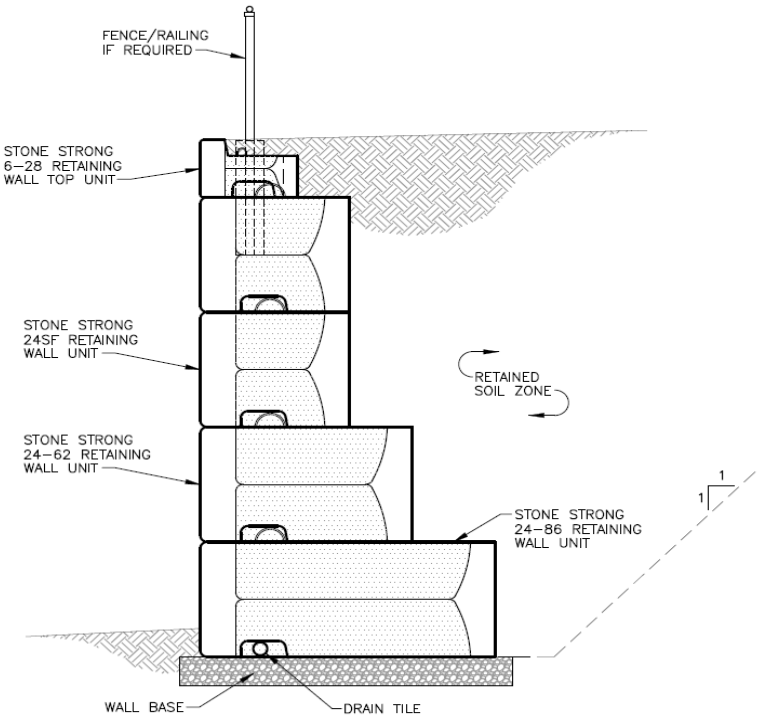
AASHTO Load Case 1 - Level Grade, No Surcharge (Vertical Face)

Backslope: flat effective grade
Surcharge: None
Standard: AASHTO LRFD Bridge Design Specifications
Retained Soil: design for weakest soil within zone extending up at 1H:1V slope starting 12 in. behind heel
foundation soil either sand (ϕ=30°) or clay (ϕ=26°, c=100psf)



Configurations shown are preliminary and conceptual, and should not be used without site specific analysis and adjustment by a licensed Professional Engineer

24-86 units may be substituted for 24-62 units
Two 6SF units may be substituted for 24SF units
6SF units may be substituted for 6-28 units

Cohesive Backfill ϕ=26°, c=0psf, γ=125pcf	Total Wall Height (ft)						
	4.5	**6.0**	**7.5**	**9.0**	**10.5**	**12.0**	**13.5**
5th Course							V6SF
4th Course					V6-28	V24SF	V24SF
3rd Course			V6-28	V24SF	V24SF	V24SF	V24SF
2nd Course	V6-28	V24SF	V24SF	V24SF	V24SF	V24-62	V24-86
Bottom Course	V24SF	V24SF	V24SF	V24-62	V24-62	V24-86	V24-86

Sand Backfill ϕ=30°, c=0psf, γ=125pcf	Total Wall Height (ft)						
	6.0	**7.5**	**9.0**	**10.5**	**12.0**	**13.5**	**15.0**
6th Course							
5th Course						V6-28	V24SF
4th Course				V6-28	V24SF	V24SF	V24SF
3rd Course		V6-28	V24SF	V24SF	V24SF	V24SF	V24SF
2nd Course	V24SF	V24SF	V24SF	V24SF	V24SF	V24-62	V24-62
Bottom Course	V24SF	V24SF	V24-62	V24-62	V24-62	V24-86	V24-86

Gravel Backfill ϕ=34°, c=0psf, γ=125pcf	Total Wall Height (ft)						
	7.5	**9.0**	**10.5**	**12.0**	**13.5**	**15.0**	**16.5**
7th Course							
6th Course							V6SF
5th Course					V6-28	V24SF	V24SF
4th Course			V6-28	V24SF	V24SF	V24SF	V24SF
3rd Course	V6-28	V24SF	V24SF	V24SF	V24SF	V24SF	V24-86
2nd Course	V24SF	V24SF	V24SF	V24SF	V24-62	V24-62	V24-86
Bottom Course	V24SF	V24SF	V24-62	V24-62	V24-86	V24-86	V24-86

Crushed Stone Backfill ϕ=38°, c=0psf, γ=125pcf	Total Wall Height (ft)						
	9.0	**10.5**	**12.0**	**13.5**	**15.0**	**16.5**	**18.0**
8th Course							- -
7th Course							- -
6th Course						V6SF	- -
5th Course				V6-28	V24SF	V24SF	- -
4th Course		V6-28	V24SF	V24SF	V24SF	V24SF	- -
3rd Course	V24SF	V24SF	V24SF	V24SF	V24SF	V24SF	- -
2nd Course	V24SF	V24SF	V24SF	V24SF	V24-62	V24-62	- -
Bottom Course	V24SF	V24SF	V24-62	V24-86	V24-86	V24-86	- -

Gravity Design Tables

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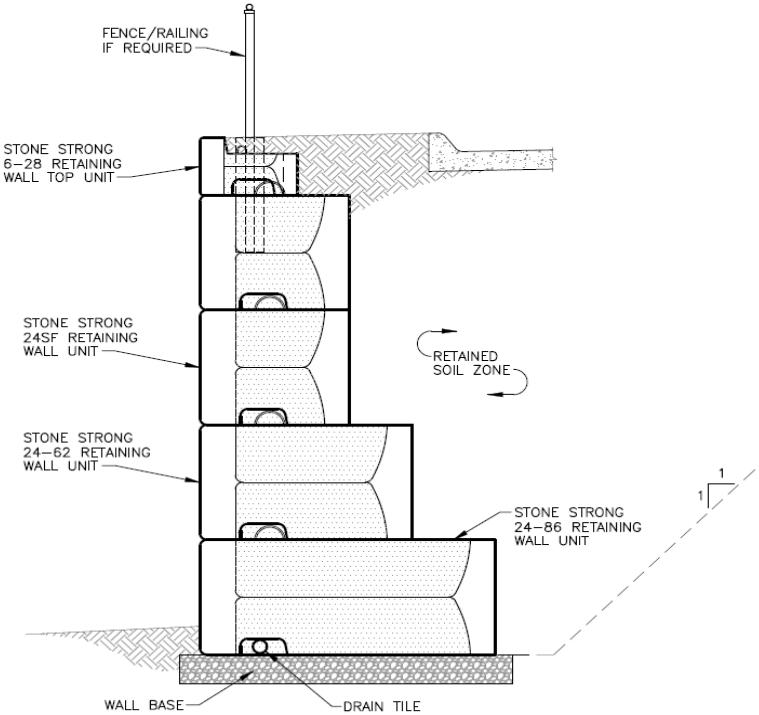
AASHTO Load Case 2 - Highway Surcharge (Vertical Face)

Backslope: flat effective grade
Surcharge: 250 psf (set back 5 ft. from face)
Standard: AASHTO LRFD Bridge Design Specifications
Retained Soil: design for weakest soil within zone extending up at 1H:1V slope starting 12 in. behind heel
foundation soil either sand (ϕ=30°) or clay (ϕ=26°, c=100psf)



Configurations shown are preliminary and conceptual, and should not be used without site specific analysis and adjustment by a licensed Professional Engineer

24-86 units may be substituted for 24-62 units
Two 6SF units may be substituted for 24SF units
6SF units may be substituted for 6-28 units

Cohesive Backfill
ϕ=26°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	3.0	4.5	6.0	7.5	9.0	10.5	12.0
5th Course							- -
4th Course						V6-28	- -
3rd Course				V6-28	V24SF	V24SF	- -
2nd Course		V6-28	V24SF	V24SF	V24SF	V24SF	- -
Bottom Course	V24SF	V24SF	V24SF	V24SF	V24-86	V24-86	- -

Sand Backfill
ϕ=30°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	4.5	6.0	7.5	9.0	10.5	12.0	13.5
6th Course							
5th Course							V6SF
4th Course					V6-28	V24SF	V24SF
3rd Course			V6-28	V24SF	V24SF	V24SF	V24SF
2nd Course	V6-28	V24SF	V24SF	V24SF	V24SF	V24-62	V24-62
Bottom Course	V24SF	V24SF	V24SF	V24-62	V24-86	V24-86	V24-86

Gravel Backfill
ϕ=34°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	6.0	7.5	9.0	10.5	12.0	13.5	15.0
7th Course							- -
6th Course							- -
5th Course						V6-28	- -
4th Course				V6-28	V24SF	V24SF	- -
3rd Course		V6-28	V24SF	V24SF	V24SF	V24SF	- -
2nd Course	V24SF	V24SF	V24SF	V24SF	V24-62	V24-62	- -
Bottom Course	V24SF	V24SF	V24-62	V24-62	V24-86	V24-86	- -

Crushed Stone Backfill
ϕ=38°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	7.5	9.0	10.5	12.0	13.5	15.0	16.5
8th Course							- -
7th Course							- -
6th Course							- -
5th Course					V6-28	V24SF	- -
4th Course			V6-28	V24SF	V24SF	V24SF	- -
3rd Course	V6-28	V24SF	V24SF	V24SF	V24SF	V24SF	- -
2nd Course	V24SF	V24SF	V24SF	V24SF	V24SF	V24-62	- -
Bottom Course	V24SF	V24-62	V24-62	V24-62	V24-86	V24-86	- -

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Gravity Design Tables

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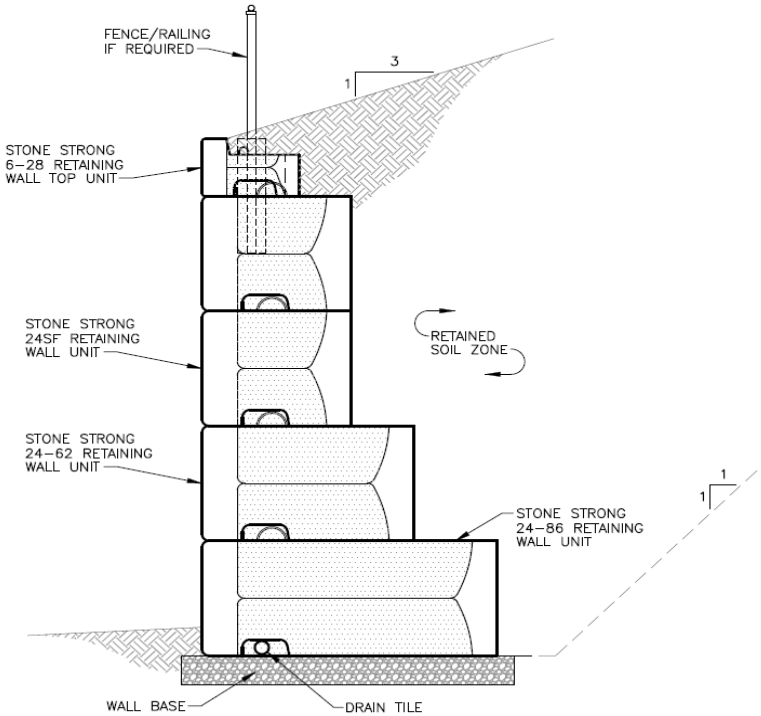
AASHTO Load Case 3 - Sloping Backfill (Vertical Face)

Backslope: 3H:1V grade above wall
Surcharge: None
Standard: AASHTO LRFD Bridge Design Specifications
Retained Soil: design for weakest soil within zone extending up at 1H:1V slope starting 12 in. behind heel
foundation soil either sand (ϕ=30°) or clay (ϕ=26°, c=100psf)



Configurations shown are preliminary and conceptual, and should not be used without site specific analysis and adjustment by a licensed Professional Engineer

24-86 units may be substituted for 24-62 units
Two 6SF units may be substituted for 24SF units
6SF units may be substituted for 6-28 units

Cohesive Backfill
ϕ=26°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	3.0	4.5	6.0	7.5	9.0	10.5	12.0
5th Course							- -
4th Course						V6-28	- -
3rd Course				V6-28	V24SF	V24SF	- -
2nd Course		V6-28	V24SF	V24SF	V24SF	V24-62	- -
Bottom Course	V24SF	V24SF	V24SF	V24-62	V24-86	V24-86	- -

Sand Backfill
ϕ=30°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	4.5	6.0	7.5	9.0	10.5	12.0	13.5
6th Course							
5th Course							V6-28
4th Course					V6-28	V24SF	V24SF
3rd Course			V6-28	V24SF	V24SF	V24SF	V24SF
2nd Course	V6-28	V24SF	V24SF	V24SF	V24SF	V24-62	V24-62
Bottom Course	V24SF	V24SF	V24SF	V24-62	V24-62	V24-86	V24-86

Gravel Backfill
ϕ=34°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	6.0	7.5	9.0	10.5	12.0	13.5	15.0
7th Course							
6th Course							
5th Course						V6-28	V24SF
4th Course				V6-28	V24SF	V24SF	V24SF
3rd Course		V6-28	V24SF	V24SF	V24SF	V24SF	V24SF
2nd Course	V24SF	V24SF	V24SF	V24SF	V24SF	V24-62	V24-86
Bottom Course	V24SF	V24SF	V24-62	V24-62	V24-62	V24-86	V24-86

Crushed Stone Backfill
ϕ=38°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	7.5	9.0	10.5	12.0	13.5	15.0	16.5
8th Course							
7th Course							
6th Course							V6SF
5th Course					V6-28	V24SF	V24SF
4th Course			V6-28	V24SF	V24SF	V24SF	V24SF
3rd Course	V6-28	V24SF	V24SF	V24SF	V24SF	V24SF	V24-86
2nd Course	V24SF	V24SF	V24SF	V24SF	V24-62	V24-62	V24-86
Bottom Course	V24SF	V24SF	V24-62	V24-62	V24-86	V24-86	V24-86

Gravity Design Tables

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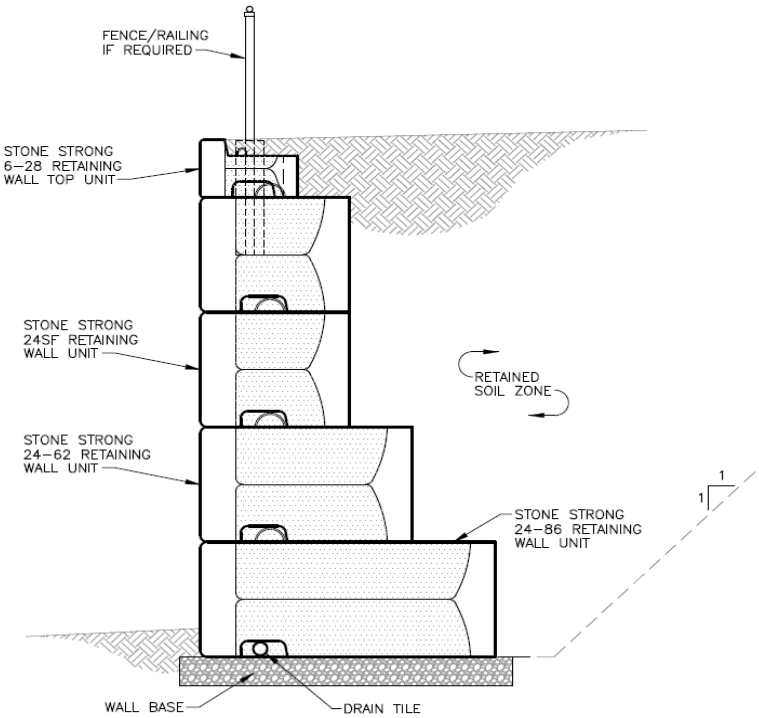
AASHTO Load Case 4 - Seismic
(Vertical Face)

Backslope: flat effective grade
Surcharge: PGA=0.20 (Live Load not concurrent)
Standard: AASHTO LRFD Bridge Design Specifications
Retained Soil: design for weakest soil within zone extending up at 1H:1V slope starting 12 in. behind heel
foundation soil either sand (ϕ=30°) or clay (ϕ=26°, c=100psf)



Configurations shown are preliminary and conceptual, and should not be used without site specific analysis and adjustment by a licensed Professional Engineer

24-86 units may be substituted for 24-62 units
Two 6SF units may be substituted for 24SF units
6SF units may be substituted for 6-28 units

Cohesive Backfill
ϕ=26°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	4.5	6.0	7.5	9.0	10.5	12.0	13.5
5th Course							V6SF
4th Course					V6-28	V24SF	V24SF
3rd Course			V6-28	V24SF	V24SF	V24SF	V24SF
2nd Course	V6-28	V24SF	V24SF	V24SF	V24SF	V24-62	V24-86
Bottom Course	V24SF	V24SF	V24SF	V24-62	V24-62	V24-86	V24-86

Sand Backfill
ϕ=30°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	6.0	7.5	9.0	10.5	12.0	13.5	15.0
6th Course							
5th Course						V6-28	V24SF
4th Course				V6-28	V24SF	V24SF	V24SF
3rd Course		V6-28	V24SF	V24SF	V24SF	V24SF	V24-62
2nd Course	V24SF	V24SF	V24SF	V24SF	V24-62	V24-62	V24-62
Bottom Course	V24SF	V24SF	V24-62	V24-62	V24-62	V24-86	V24-86

Gravel Backfill
ϕ=34°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	7.5	9.0	10.5	12.0	13.5	15.0	16.5
7th Course							- -
6th Course							V6SF
5th Course					V6-28	V24SF	V24SF
4th Course			V6-28	V24SF	V24SF	V24SF	V24SF
3rd Course	V6-28	V24SF	V24SF	V24SF	V24SF	V24-62	V24-86
2nd Course	V24SF	V24SF	V24SF	V24-62	V24-62	V24-62	V24-86
Bottom Course	V24SF	V24SF	V24-62	V24-62	V24-86	V24-86	V24-86

Crushed Stone Backfill
ϕ=38°, c=0psf, γ=125pcf

	Total Wall Height (ft)						
	9.0	10.5	12.0	13.5	15.0	16.5	18.0
8th Course							- -
7th Course							- -
6th Course						V6-28	- -
5th Course				V6-28	V24SF	V24SF	- -
4th Course		V6-28	V24SF	V24SF	V24SF	V24SF	- -
3rd Course	V24SF	V24SF	V24SF	V24SF	V24SF	V24-62	- -
2nd Course	V24SF	V24SF	V24SF	V24-62	V24-62	V24-86	- -
Bottom Course	V24SF	V24SF	V24-62	V24-62	V24-86	V24-86	- -

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Gravity Design Tables

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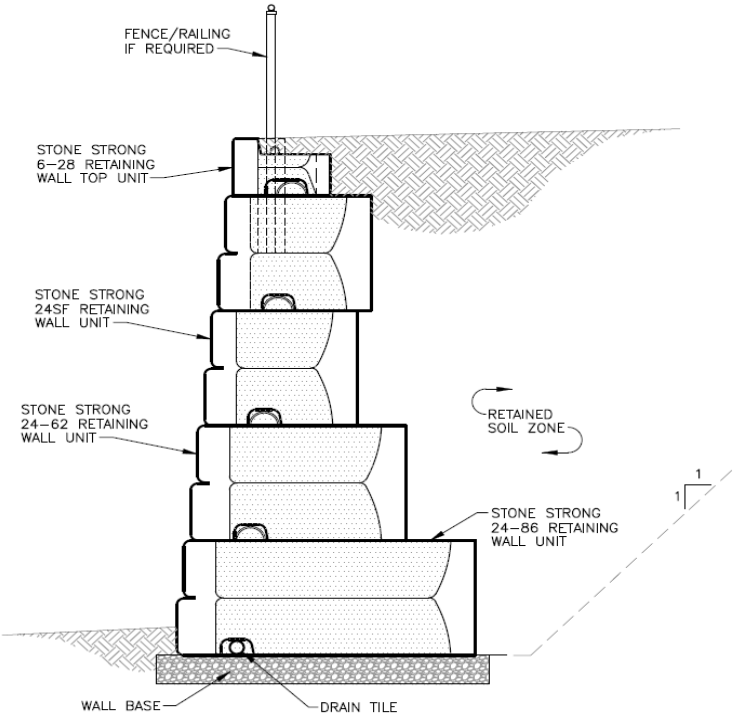
CHBDC Load Case 1 - Level Grade, No Surcharge (Battered Face)

Backslope: flat effective grade
Surcharge: None
Standard: CSA S6:19 Canadian Highway Bridge Design Code
Retained Soil: design for weakest soil within zone extending up at 1H:1V slope starting 300 mm behind heel
foundation soil either sand (ϕ=30°) or clay (ϕ=26°, c=5 kPa)



Configurations shown are preliminary and conceptual, and should not be used without site specific analysis and adjustment by a licensed Professional Engineer

24-86 units may be substituted for 24-62 units
Two 6SF units may be substituted for 24SF units
6SF units may be substituted for 6-28 units

Cohesive Backfill
ϕ=26°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	1.8	2.3	2.7	3.2	3.7	4.1	4.6
5th Course						6SF	- -
4th Course				6SF	24SF	24SF	- -
3rd Course		6-28	24SF	24SF	24SF	24-62	- -
2nd Course	24SF	24SF	24SF	24SF	24-62	24-86	- -
Bottom Course	24SF	24SF	24-62	24-62	24-86	24-86	- -

Sand Backfill
ϕ=30°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	2.3	2.7	3.2	3.7	4.1	4.6	5.0
6th Course							6SF
5th Course					6-28	24SF	24SF
4th Course			6-28	24SF	24SF	24SF	24SF
3rd Course	6-28	24SF	24SF	24SF	24SF	24SF	24-62
2nd Course	24SF	24SF	24SF	24SF	24-62	24-62	24-86
Bottom Course	24SF	24SF	24-62	24-62	24-86	24-86	24-86

Gravel Backfill
ϕ=34°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	2.7	3.2	3.7	4.1	4.6	5.0	5.5
7th Course							
6th Course						6-28	24SF
5th Course				6-28	24SF	24SF	24SF
4th Course		6-28	24SF	24SF	24SF	24SF	24SF
3rd Course	24SF	24SF	24SF	24SF	24SF	24SF	24-62
2nd Course	24SF	24SF	24SF	24SF	24-62	24-86	24-86
Bottom Course	24SF	24SF	24-62	24-62	24-62	24-86	24-86

Crushed Stone Backfill
ϕ=38°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	3.2	3.7	4.1	4.6	5.0	5.5	5.9
8th Course							
7th Course							6-28
6th Course					6-28	24SF	24SF
5th Course			6-28	24SF	24SF	24SF	24SF
4th Course	6-28	24SF	24SF	24SF	24SF	24SF	24SF
3rd Course	24SF	24SF	24SF	24SF	24SF	24SF	24-62
2nd Course	24SF	24SF	24SF	24SF	24-62	24-62	24-86
Bottom Course	24SF	24SF	24-62	24-62	24-86	24-86	24-86

Gravity Design Tables

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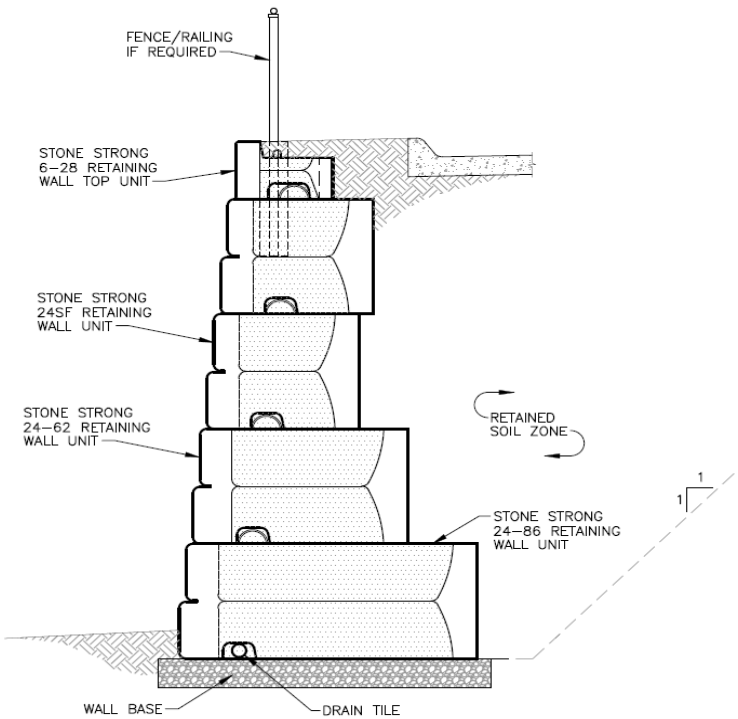
CHBDC Load Case 2 - Highway Surcharge (Battered Face)

Backslope: flat effective grade
Surcharge: 16 kPa (set back 1.5 m from face)
Standard: CSA S6:19 Canadian Highway Bridge Design Code
Retained Soil: design for weakest soil within zone extending up at 1H:1V slope starting 300 mm behind heel
foundation soil either sand (ϕ=30°) or clay (ϕ=26°, c=5 kPa)



Configurations shown are preliminary and conceptual, and should not be used without site specific analysis and adjustment by a licensed Professional Engineer

24-86 units may be substituted for 24-62 units
Two 6SF units may be substituted for 24SF units
6SF units may be substituted for 6-28 units

Cohesive Backfill
ϕ=26°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	0.9	1.4	1.8	2.3	2.7	3.2	3.7
5th Course						- -	- -
4th Course						- -	- -
3rd Course				6-28	24SF	- -	- -
2nd Course		6-28	24SF	24SF	24-86	- -	- -
Bottom Course	24SF	24SF	24-62	24-86	24-86	- -	- -

Sand Backfill
ϕ=30°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	1.4	1.8	2.3	2.7	3.2	3.7	4.1
6th Course						- -	- -
5th Course						- -	- -
4th Course					6-28	- -	- -
3rd Course			6-28	24SF	24SF	- -	- -
2nd Course	6-28	24SF	24SF	24-62	24-62	- -	- -
Bottom Course	24SF	24-62	24-62	24-86	24-86	- -	- -

Gravel Backfill
ϕ=34°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	1.8	2.3	2.7	3.2	3.7	4.1	4.6
7th Course							- -
6th Course							- -
5th Course						6-28	- -
4th Course				6-28	24SF	24SF	- -
3rd Course		6-28	24SF	24SF	24SF	24SF	- -
2nd Course	24SF	24SF	24SF	24SF	24-62	24-86	- -
Bottom Course	24SF	24SF	24-62	24-86	24-86	24-86	- -

Crushed Stone Backfill
ϕ=38°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	2.3	2.7	3.2	3.7	4.1	4.6	5.0
8th Course							
7th Course							
6th Course							6-28
5th Course					6-28	24SF	24SF
4th Course			6-28	24SF	24SF	24SF	24SF
3rd Course	6-28	24SF	24SF	24SF	24SF	24-62	24-62
2nd Course	24SF	24SF	24SF	24-62	24-62	24-62	24-86
Bottom Course	24SF	24-62	24-62	24-62	24-86	24-86	24-86

Gravity Design Tables

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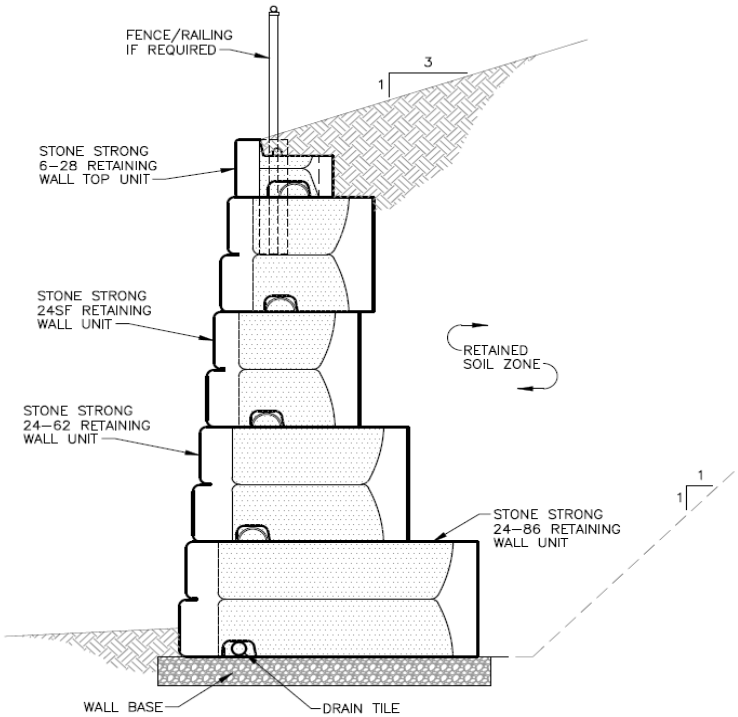
CHBDC Load Case 3 - Sloping Backfill (Battered Face)

Backslope: 3H:1V grade above wall
Surcharge: None
Standard: CSA S6:19 Canadian Highway Bridge Design Code
Retained Soil: design for weakest soil within zone extending up at 1H:1V slope starting 300 mm behind heel
foundation soil either sand (ϕ=30°) or clay (ϕ=26°, c=5 kPa)



Configurations shown are preliminary and conceptual, and should not be used without site specific analysis and adjustment by a licensed Professional Engineer

24-86 units may be substituted for 24-62 units
Two 6SF units may be substituted for 24SF units
6SF units may be substituted for 6-28 units

Cohesive Backfill
ϕ=26°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	0.9	1.4	1.8	2.3	2.7	3.2	3.7
5th Course						- -	- -
4th Course						- -	- -
3rd Course				6-28	24SF	- -	- -
2nd Course		6-28	24SF	24SF	24SF	- -	- -
Bottom Course	24SF	24SF	24SF	24-62	24-86	- -	- -

Sand Backfill
ϕ=30°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	1.4	1.8	2.3	2.7	3.2	3.7	4.1
6th Course							- -
5th Course							- -
4th Course					6SF	24SF	- -
3rd Course			6-28	24SF	24SF	24SF	- -
2nd Course	6-28	24SF	24SF	24SF	24SF	24-86	- -
Bottom Course	24SF	24SF	24SF	24-62	24-86	24-86	- -

Gravel Backfill
ϕ=34°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	2.3	2.7	3.2	3.7	4.1	4.6	5.0
7th Course							- -
6th Course							- -
5th Course					6-28	24SF	- -
4th Course			6-28	24SF	24SF	24SF	- -
3rd Course	6-28	24SF	24SF	24SF	24SF	24SF	- -
2nd Course	24SF	24SF	24SF	24SF	24-62	24-86	- -
Bottom Course	24SF	24SF	24-62	24-62	24-86	24-86	- -

Crushed Stone Backfill
ϕ=38°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	2.7	3.2	3.7	4.1	4.6	5.0	5.5
8th Course							
7th Course							
6th Course						6-28	24SF
5th Course				6-28	24SF	24SF	24SF
4th Course		6-28	24SF	24SF	24SF	24SF	24SF
3rd Course	24SF	24SF	24SF	24SF	24SF	24SF	24-62
2nd Course	24SF	24SF	24SF	24SF	24-62	24-62	24-86
Bottom Course	24SF	24SF	24-62	24-62	24-86	24-86	24-86

Gravity Design Tables

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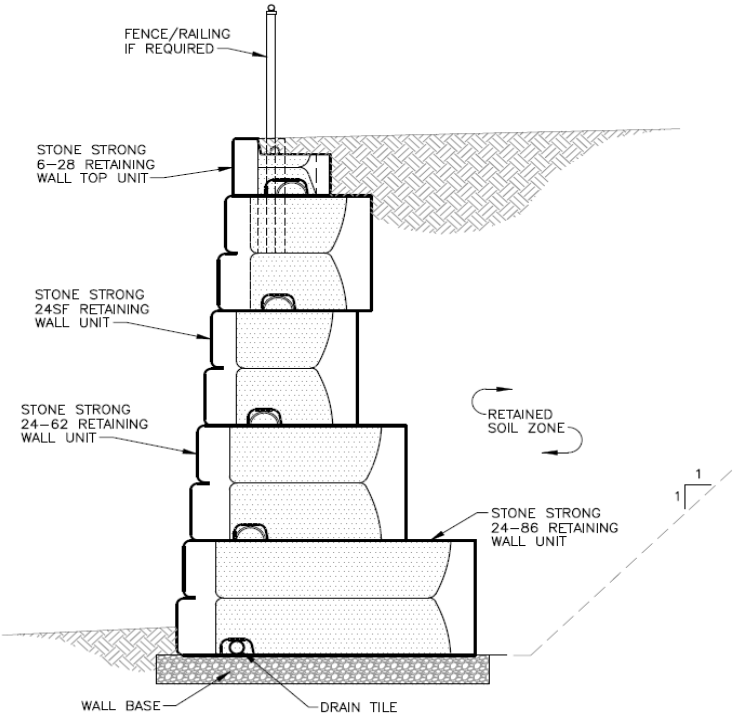
CHBDC Load Case 4 - Seismic
(Battered Face)

Backslope: flat effective grade
Surcharge: PGA=0.20 (Live Load not concurrent)
Standard: CSA S6:19 Canadian Highway Bridge Design Code
Retained Soil: design for weakest soil within zone extending up at 1H:1V slope starting 300 mm behind heel
foundation soil either sand (ϕ=30°) or clay (ϕ=26°, c=5 kPa)



Configurations shown are preliminary and conceptual, and should not be used without site specific analysis and adjustment by a licensed Professional Engineer

24-86 units may be substituted for 24-62 units
Two 6SF units may be substituted for 24SF units
6SF units may be substituted for 6-28 units

Cohesive Backfill
ϕ=26°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	1.8	**2.3**	**2.7**	**3.2**	**3.7**	**4.1**	**4.6**
5th Course						6SF	- -
4th Course				6-28	24SF	24SF	- -
3rd Course		6-28	24SF	24SF	24SF	24-62	- -
2nd Course	24SF	24SF	24SF	24SF	24-62	24-86	- -
Bottom Course	24SF	24SF	24-62	24-86	24-86	24-86	- -

Sand Backfill
ϕ=30°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	2.3	**2.7**	**3.2**	**3.7**	**4.1**	**4.6**	**5.0**
6th Course							- -
5th Course					6-28	24SF	- -
4th Course			6-28	24SF	24SF	24SF	- -
3rd Course	6-28	24SF	24SF	24SF	24SF	24-62	- -
2nd Course	24SF	24SF	24SF	24-62	24-62	24-86	- -
Bottom Course	24SF	24-62	24-62	24-86	24-86	24-86	- -

Gravel Backfill
ϕ=34°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	2.7	**3.2**	**3.7**	**4.1**	**4.6**	**5.0**	**5.5**
7th Course							- -
6th Course						6-28	- -
5th Course				6-28	24SF	24SF	- -
4th Course		6-28	24SF	24SF	24SF	24SF	- -
3rd Course	24SF	24SF	24SF	24SF	24-62	24-62	- -
2nd Course	24SF	24SF	24-62	24-62	24-62	24-86	- -
Bottom Course	24-62	24-62	24-62	24-86	24-86	24-86	- -

Crushed Stone Backfill
ϕ=38°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	3.2	**3.7**	**4.1**	**4.6**	**5.0**	**5.5**	**5.9**
8th Course							- -
7th Course							- -
6th Course					6-28	24SF	- -
5th Course			6-28	24SF	24SF	24SF	- -
4th Course	6-28	24SF	24SF	24SF	24SF	24SF	- -
3rd Course	24SF	24SF	24SF	24SF	24-62	24-86	- -
2nd Course	24SF	24SF	24-62	24-62	24-86	24-86	- -
Bottom Course	24-62	24-62	24-62	24-86	24-86	24-86	- -

Gravity Design Tables

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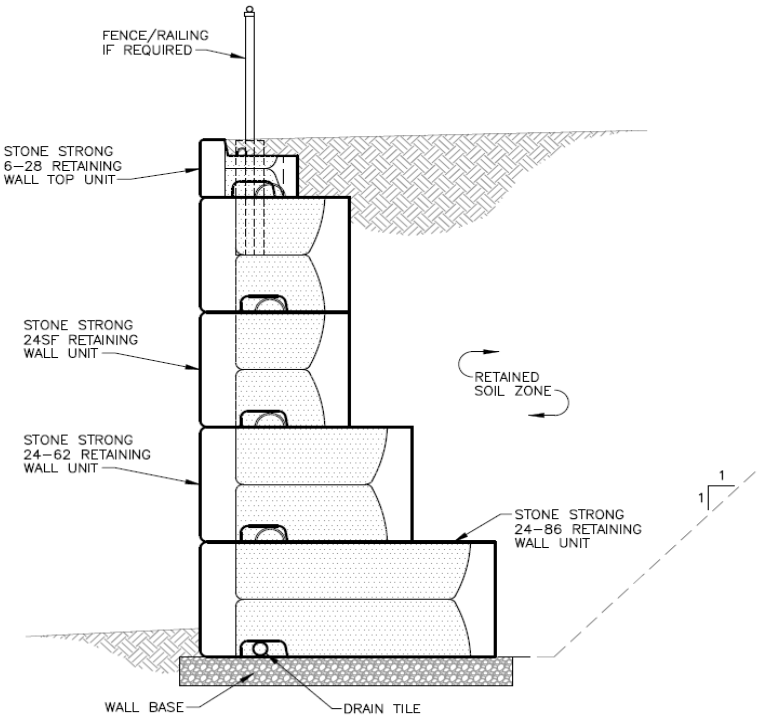
CHBDC Load Case 1 - Level Grade, No Surcharge (Vertical Face)

Backslope: flat effective grade
Surcharge: None
Standard: CSA S6:19 Canadian Highway Bridge Design Code
Retained Soil: design for weakest soil within zone extending up at 1H:1V slope starting 300 mm behind heel
foundation soil either sand (ϕ=30°) or clay (ϕ=26°, c=5 kPa)



Configurations shown are preliminary and conceptual, and should not be used without site specific analysis and adjustment by a licensed Professional Engineer

24-86 units may be substituted for 24-62 units
Two 6SF units may be substituted for 24SF units
6SF units may be substituted for 6-28 units

Cohesive Backfill ϕ=26°, c=0kPa, γ=20kN/m^3	Total Wall Height (m)						
	1.4	**1.8**	**2.3**	**2.7**	**3.2**	**3.7**	**4.1**
5th Course							V6-28
4th Course					V6-28	V24SF	V24SF
3rd Course			V6-28	V24SF	V24SF	V24SF	V24SF
2nd Course	V6-28	V24SF	V24SF	V24SF	V24SF	V24-62	V24-86
Bottom Course	V24SF	V24SF	V24SF	V24-62	V24-62	V24-86	V24-86

Sand Backfill ϕ=30°, c=0kPa, γ=20kN/m^3	Total Wall Height (m)						
	1.8	**2.3**	**2.7**	**3.2**	**3.7**	**4.1**	**4.6**
6th Course							
5th Course						V6-28	V24SF
4th Course				V6-28	V24SF	V24SF	V24SF
3rd Course		V6-28	V24SF	V24SF	V24SF	V24SF	V24-62
2nd Course	V24SF	V24SF	V24SF	V24SF	V24-62	V24-62	V24-86
Bottom Course	V24SF	V24SF	V24-62	V24-62	V24-62	V24-86	V24-86

Gravel Backfill ϕ=34°, c=0kPa, γ=20kN/m^3	Total Wall Height (m)						
	2.3	**2.7**	**3.2**	**3.7**	**4.1**	**4.6**	**5.0**
7th Course							
6th Course							V6-28
5th Course					V6-28	V24SF	V24SF
4th Course			V6-28	V24SF	V24SF	V24SF	V24SF
3rd Course	V6-28	V24SF	V24SF	V24SF	V24SF	V24-62	V24-62
2nd Course	V24SF	V24SF	V24SF	V24-62	V24-62	V24-62	V24-86
Bottom Course	V24SF	V24SF	V24-62	V24-62	V24-86	V24-86	V24-86

Crushed Stone Backfill ϕ=38°, c=0kPa, γ=20kN/m^3	Total Wall Height (m)						
	2.7	**3.2**	**3.7**	**4.1**	**4.6**	**5.0**	**5.5**
8th Course							
7th Course							
6th Course						V6-28	V24SF
5th Course				V6-28	V24SF	V24SF	V24SF
4th Course		V6-28	V24SF	V24SF	V24SF	V24SF	V24SF
3rd Course	V24SF	V24SF	V24SF	V24SF	V24SF	V24SF	V24-62
2nd Course	V24SF	V24SF	V24SF	V24SF	V24-62	V24-86	V24-86
Bottom Course	V24SF	V24SF	V24-62	V24-86	V24-86	V24-86	V24-86

Gravity Design Tables

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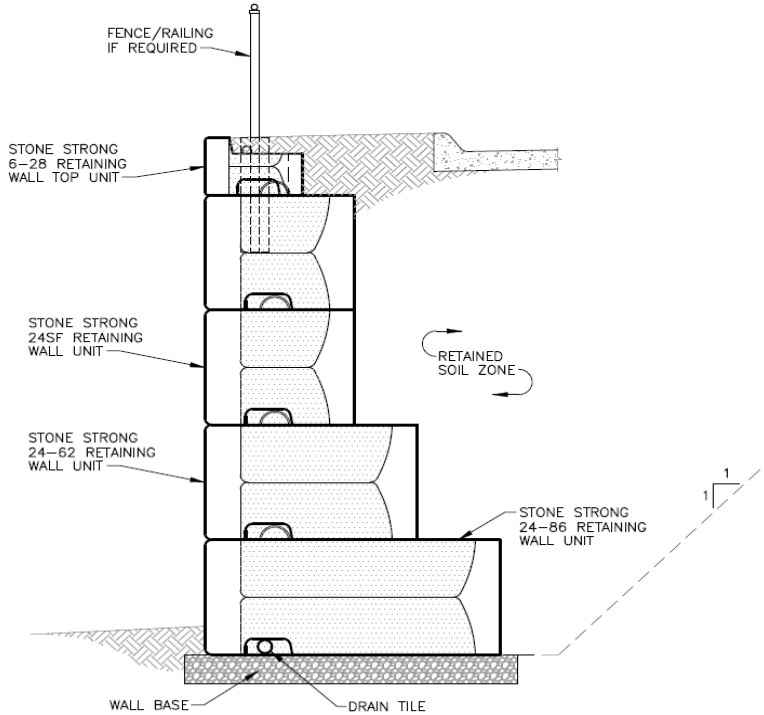
CHBDC Load Case 2 - Highway Surcharge (Vertical Face)

Backslope: flat effective grade
Surcharge: 16 kPa (set back 1.5 m from face)
Standard: CSA S6:19 Canadian Highway Bridge Design Code
Retained Soil: design for weakest soil within zone extending up at 1H:1V slope starting 300 mm behind heel
foundation soil either sand (ϕ=30°) or clay (ϕ=26°, c=5 kPa)



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24-86 units may be substituted for 24-62 units
Two 6SF units may be substituted for 24SF units
6SF units may be substituted for 6-28 units

Cohesive Backfill
ϕ=26°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	0.9	1.4	1.8	2.3	2.7	3.2	3.7
5th Course						- -	- -
4th Course						- -	- -
3rd Course				V6-28	V24SF	- -	- -
2nd Course		V6-28	V24SF	V24SF	V24-62	- -	- -
Bottom Course	V24SF	V24SF	V24-62	V24-62	V24-86	- -	- -

Sand Backfill
ϕ=30°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	1.4	1.8	2.3	2.7	3.2	3.7	4.1
6th Course							- -
5th Course							- -
4th Course					V6-28	V24SF	- -
3rd Course			V6-28	V24SF	V24SF	V24-62	- -
2nd Course	V6-28	V24SF	V24SF	V24-62	V24-62	V24-86	- -
Bottom Course	V24SF	V24-62	V24-62	V24-86	V24-86	V24-86	- -

Gravel Backfill
ϕ=34°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	1.8	2.3	2.7	3.2	3.7	4.1	4.6
7th Course							- -
6th Course							- -
5th Course						V6-28	- -
4th Course				V6-28	V24SF	V24SF	- -
3rd Course		V6-28	V24SF	V24SF	V24SF	V24SF	- -
2nd Course	V24SF	V24SF	V24SF	V24SF	V24-62	V24-86	- -
Bottom Course	V24SF	V24SF	V24-62	V24-86	V24-86	V24-86	- -

Crushed Stone Backfill
ϕ=38°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	2.3	2.7	3.2	3.7	4.1	4.6	5.0
8th Course							- -
7th Course							- -
6th Course							- -
5th Course					V6-28	V24SF	- -
4th Course			V6-28	V24SF	V24SF	V24SF	- -
3rd Course	V6-28	V24SF	V24SF	V24SF	V24SF	V24-62	- -
2nd Course	V24SF	V24SF	V24SF	V24-62	V24-62	V24-86	- -
Bottom Course	V24SF	V24-62	V24-62	V24-86	V24-86	V24-86	- -

Gravity Design Tables

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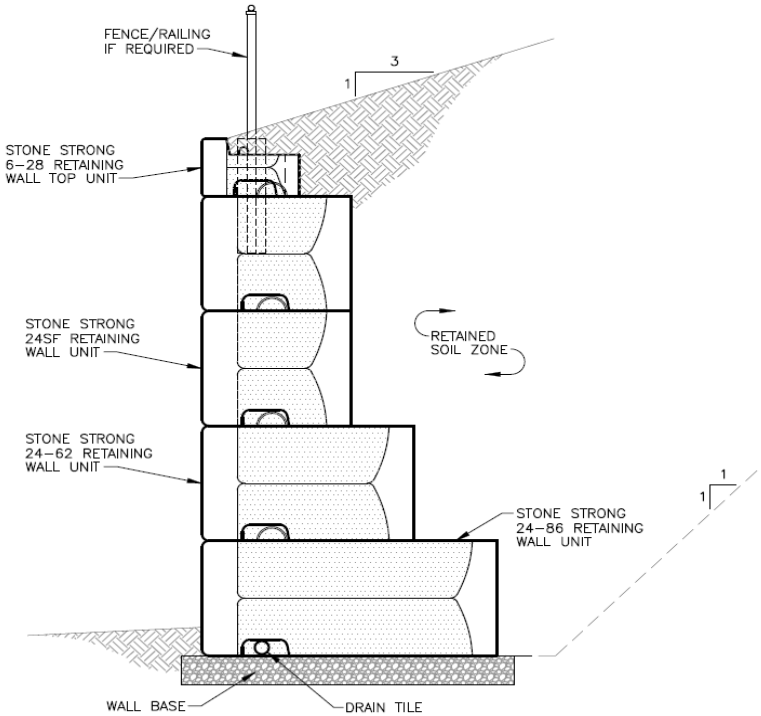
CHBDC Load Case 3 - Sloping Backfill
(Vertical Face)

Backslope: 3H:1V grade above wall
Surcharge: None
Standard: CSA S6:19 Canadian Highway Bridge Design Code
Retained Soil: design for weakest soil within zone extending up at 1H:1V slope starting 300 mm behind heel
foundation soil either sand (ϕ=30°) or clay (ϕ=26°, c=5 kPa)



Configurations shown are preliminary and conceptual, and should not be used without site specific analysis and adjustment by a licensed Professional Engineer

24-86 units may be substituted for 24-62 units
Two 6SF units may be substituted for 24SF units
6SF units may be substituted for 6-28 units

Cohesive Backfill ϕ=26°, c=0kPa, γ=20kN/m^3	Total Wall Height (m)						
	0.9	**1.4**	**1.8**	**2.3**	**2.7**	**3.2**	**3.7**
5th Course							- -
4th Course						V6-28	- -
3rd Course				V6-28	V24SF	V24-62	- -
2nd Course		V6-28	V24SF	V24SF	V24SF	V24-86	- -
Bottom Course	V24SF	V24SF	V24SF	V24-62	V24-86	V24-86	- -

Sand Backfill ϕ=30°, c=0kPa, γ=20kN/m^3	Total Wall Height (m)						
	1.4	**1.8**	**2.3**	**2.7**	**3.2**	**3.7**	**4.1**
6th Course							- -
5th Course							- -
4th Course					V6-28	V24SF	- -
3rd Course			V6-28	V24SF	V24SF	V24SF	- -
2nd Course	V6-28	V24SF	V24SF	V24SF	V24SF	V24-62	- -
Bottom Course	V24SF	V24SF	V24SF	V24-62	V24-86	V24-86	- -

Gravel Backfill ϕ=34°, c=0kPa, γ=20kN/m^3	Total Wall Height (m)						
	1.8	**2.3**	**2.7**	**3.2**	**3.7**	**4.1**	**4.6**
7th Course							
6th Course							
5th Course						V6-28	V24SF
4th Course				V6-28	V24SF	V24SF	V24SF
3rd Course		V6-28	V24SF	V24SF	V24SF	V24SF	V24-62
2nd Course	V24SF	V24SF	V24SF	V24SF	V24-62	V24-62	V24-86
Bottom Course	V24SF	V24SF	V24-62	V24-62	V24-62	V24-86	V24-86

Crushed Stone Backfill ϕ=38°, c=0kPa, γ=20kN/m^3	Total Wall Height (m)						
	2.3	**2.7**	**3.2**	**3.7**	**4.1**	**4.6**	**5.0**
8th Course							
7th Course							
6th Course							V6-28
5th Course					V6-28	V24SF	V24SF
4th Course			V6-28	V24SF	V24SF	V24SF	V24SF
3rd Course	V6-28	V24SF	V24SF	V24SF	V24SF	V24-62	V24-62
2nd Course	V24SF	V24SF	V24SF	V24-62	V24-62	V24-62	V24-86
Bottom Course	V24SF	V24SF	V24-62	V24-62	V24-86	V24-86	V24-86

Gravity Design Tables

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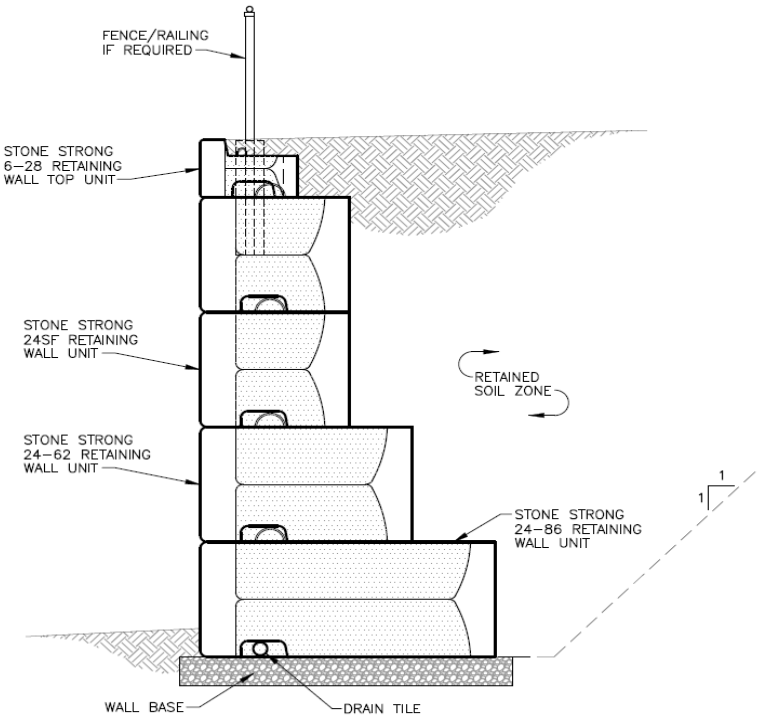
CHBDC Load Case 4 - Seismic
(Vertical Face)

Backslope: flat effective grade
Surcharge: PGA=0.20 (Live Load not concurrent)
Standard: CSA S6:19 Canadian Highway Bridge Design Code
Retained Soil: design for weakest soil within zone extending up at 1H:1V slope starting 300 mm behind heel
foundation soil either sand (ϕ=30°) or clay (ϕ=26°, c=5 kPa)



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24-86 units may be substituted for 24-62 units
Two 6SF units may be substituted for 24SF units
6SF units may be substituted for 6-28 units

Cohesive Backfill
ϕ=26°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	1.4	1.8	2.3	2.7	3.2	3.7	4.1
5th Course							V6-28
4th Course					V6-28	V24SF	V24SF
3rd Course			V6-28	V24SF	V24SF	V24SF	V24-62
2nd Course	V6-28	V24SF	V24SF	V24SF	V24-62	V24-62	V24-86
Bottom Course	V24SF	V24SF	V24SF	V24-62	V24-86	V24-86	V24-86

Sand Backfill
ϕ=30°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	1.8	2.3	2.7	3.2	3.7	4.1	4.6
6th Course							
5th Course						V6-28	V24SF
4th Course				V6-28	V24SF	V24SF	V24SF
3rd Course		V6-28	V24SF	V24SF	V24SF	V24SF	V24-86
2nd Course	V24SF	V24SF	V24SF	V24SF	V24-62	V24-86	V24-86
Bottom Course	V24SF	V24SF	V24-62	V24-62	V24-86	V24-86	V24-86

Gravel Backfill
ϕ=34°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	2.3	2.7	3.2	3.7	4.1	4.6	5.0
7th Course							- -
6th Course							- -
5th Course					V6-28	V24SF	- -
4th Course			V6-28	V24SF	V24SF	V24SF	- -
3rd Course	V6-28	V24SF	V24SF	V24SF	V24SF	V24-62	- -
2nd Course	V24SF	V24SF	V24SF	V24-62	V24-62	V24-86	- -
Bottom Course	V24SF	V24-62	V24-62	V24-86	V24-86	V24-86	- -

Crushed Stone Backfill
ϕ=38°, c=0kPa, γ=20kN/m^3

	Total Wall Height (m)						
	2.7	3.2	3.7	4.1	4.6	5.0	5.5
8th Course							- -
7th Course							- -
6th Course						V6SF	- -
5th Course				V6-28	V24SF	V24SF	- -
4th Course		V6-28	V24SF	V24SF	V24SF	V24SF	- -
3rd Course	V24SF	V24SF	V24SF	V24SF	V24-62	V24-86	- -
2nd Course	V24SF	V24SF	V24-62	V24-62	V24-86	V24-86	- -
Bottom Course	V24-62	V24-62	V24-62	V24-86	V24-86	V24-86	- -