

Number: **E-04-005**

Date: **April 16, 2004**

ENGINEERING DIRECTIVE

Thomas F. Broslevick

CHIEF ENGINEER

CANTILEVER RETAINING WALLS

Effective immediately, the 1996 Metric Edition Construction and Traffic Standard Details and the 1977 [English Edition] Construction Standards are amended with the following new drawings (attached):

Typical Cantilever Retaining Wall Section 305.1.0 Cantilever Retaining Walls - Dense Foundation Soils, Sloping Backfill 305.2.0 Cantilever Retaining Walls - Dense Foundation Soils, Level Backfill, 305.3.0 Surcharge 305.4.0 Cantilever Retaining Walls - Loose Foundation Soils, Sloping Backfill Cantilever Retaining Walls - Loose Foundation Soils, Level Backfill, 305.5.0 Surcharge 305.6.0 Cantilever Retaining Walls - Rock Foundation, Sloping Backfill Cantilever Retaining Walls - Rock Foundation, Level Backfill, Surcharge 305.7.0

These drawings may be used on any applicable project, effective immediately. For projects designed in Metric units, dimensions and quantities shown on these drawings shall be converted to logical Metric units with the approval of the Projects Division.

If Cantilever Retaining Walls are used, the contract documents shall include Special Provisions that describe the work, location(s) and any known geotechnical information that indicates the nature or strength of the foundation material(s).

The Resident Engineer shall confirm that the design parameters are appropriate based on actual field conditions. If no geotechnical information is available, the Resident Engineer should request assistance from the Geotechnical Engineer prior to authorizing construction of the wall(s). In these cases, the Geotechnical Engineer shall determine the foundation condition(s). Discrepancies regarding foundation conditions shall be resolved through consultation between the Resident Engineer, the designer, the contractor and the Geotechnical Engineer.

All cement concrete shall be placed in accordance with the requirements of Section 901. Cement Concrete Masonry and shall meet the material requirements of Section M4.02.00 Cement Concrete. All reinforcing steel shall meet the material requirements of Section M8.01.0 Reinforcing Bars.

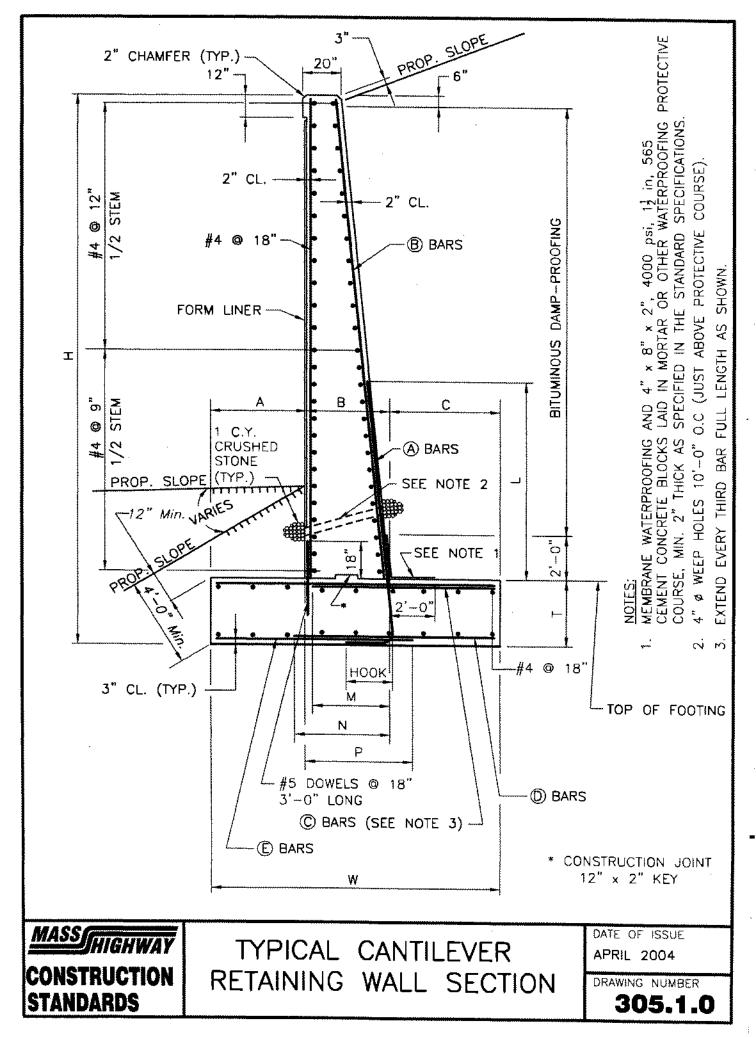
Cantilever Retaining Walls shall be estimated and bid using the following items:

693.	Concrete for Wall Footing	Cubic Yard, Cubic Meter
694.	Concrete for Wall Stem	Cubic Yard, Cubic Meter
695.	Reinforcing Steel	Pound, Kilogram

Payment under these items shall include compensation for all necessary labor, equipment and materials to complete the work to the satisfaction of the Engineer. Necessary weep holes shall be included under Item 694. Necessary form liners shall be paid under a separate item, unless specified otherwise.

Excavation shall be paid for at the contract unit prices under Item 141. Class A Trench Excavation or Item 144. Class B Rock Excavation. Payment under these items shall include full compensation for all necessary shoring or sheeting. Backfilling shall be paid for at the contract unit price under Item 151.2 Gravel Borrow for Backfilling Structures and Pipes. Bituminous Damp-Proofing shall be paid for at the contract unit price under Item 970. Bituminous Damp-Proofing.

Attachments:



STANDARDS	CONSTRUCTION	MASSIFIGHWAY

DENSE FOUNDATION SO

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APRIL DATE

2004

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ISSUE

305.2.0

							TAS	HENEN	MENSIONS /	NO DEINE	OBOING ST	reci					
H	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0		25.0	26.0	27.0	28.0	29.0	30.0
							<u> </u>				24.0						
W	8.500	9.000	19,000	10.500	11.000	12.000	12.500	13.000	13.500	14.000	15.000	15.500	16.500	17.500	18.000	19,000	20.000
Т	2.000	2.000	2.000	2.000	2.000	2,000	2.500	2,500	1,000	3.000	3,500	3,500	4.000	4.000	4,500	4,500	5,000
A	1.500	1.500	2.000	2.000	1,500	Z.000	2,000	2.000	2.000	2.000	2,500	2.500	3.000	3.500	4,000	4,500	5,000
8	2,500	2.583	2.687	2.750	2.833	2.917	2.958	3,042	3.083	3.167	3.208	3.292	3,333	3.417	3.458	3.542	3,583
C	4.500	4.917	5.333	5.750	6.667	7.083	7.542	7.958	8.417	8.633	9.292	9.708	10.167	10.583	10.542	10.958	11,417
L	3.600	3.900	5.600	6.000	8.000	8.500	8.750	9.250	9.500	12.000	12.300	12.900	13.200	13,800	14.100	14,700	15,000
M	1.917	2.500	3.167	4.083	5,000	6.000	5,000	5.000	5,000	5.000	5.000	5.000	5.000	5,000	5.000	6.000	5.000
N	1.000	1.000	1,000	1.000	1.250	1,250	1.250	1,250	1.250	1.500	1,500	1,500	1.917	1.917	1.917	1.917	1.917
ļ P	1,000	1.000	1.250	1.250	1.000	1.250	1.250	1.250	1,250	1.250	1.250	1,250	1,500	1,917	1.917	2,500	2.500
ноок	1.000	1.167	1.167	1.333	1.333	1.583	1.583	1.833	1,833	1.833	2,000	2,000	1.583	1.583	1.583	1.583	1.833

A bers	6@12	7@12	7@12	8@12	8@12	9@12	9@12	10@12	10@12	10@12	11@12	11 @ 12	9@6	9@6	9@6	9@6	10@6
B bars	4@12	4@12	4@12	4@12	4 @ 12	4@12	4@12	4@12	4@12	4@12	4 @ 12	4@12	4@12	4 @ 12	4@12	4@12	4@12
C bars	7@18	8@18	9@18	10 @ 18	11@17	11 @ 14	11 @ 15.5	11@13	11@13.5	11@12	11@12	11 @ 10.5	11 @ 10.5	11 @ 9.5	11 @ 10.5	11 @ 9.5	11@9.5
D bars	4@18	4@18	4@18	4@18	5 @ 18	5@18	5@18	5@18	5 @ 18	6@18	5@18	6@18	7@18	7@18	7@18	7@18	7@18
E bars	4@18	4@18	5@18	5@18	4@18	5@18	5@18	5@18	5@18	5@18	5@18	5@18	6@18	7@18	7@18	8 @ 18	8@18
		ī						Quan	tities of Mal	erials							
Stem Concrete (yd 1/ft)	0.9	1,0	1.1	1.2	1.3	1.4	1.4	1.6	1.6	1.7	1.8	1,9	2.0	2.1	2.2	2.3	2.4
Footing Concrete (yd 1/ft)	0.6	0.7	0.7	0.8	6.8	0.9	1.2	1.2	1,5	1.6	2.0	2.0	2.5	2.6	3.0	3.2	3.7
										· · · · · · · · · · · · · · · · · · ·				- -			
Steel (lb/ft)	98	117	152	171	200	233	243	280	292	399	454	470	488	510	524	550	631
		·····						Maximum	Soll Bearing	Pressure							
Q _{max} (psf)	5123	5663	5432	5954	7019	6759	7346	7886	8482	9033	8817	9355	9178	8984	9103	8948	8892
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Notes:

- All dimensions are in feet, unless specified otherwise.
- Spacings of reinforcing bars are in inches.
- 3. Designer must confirm design parameters with Geotechnical Engineer prior to selecting wall for site.

ASSUMED DESIGN PARAMETERS

DENSE FOUNDATION SOIL, SLOPING BACKFILL

- 1. BACKFILL LOADING CONDITIONS:
 - 3. FOUNDATION SOIL PROPERTIES:

5. REINFORCED CONCRETE:

2H:1V SLOPING BACKFILL

Q * FACTORED BEARING CAPACITY = 9400 psf

F' = 4000 psi

FRICTION FACTOR = 0.57

Fy = 60000 psi

2. BACKFILL SOIL PROPERTIES:

\$ PERFORMANCE FACTOR FOR SLIDING = 0,80

TYPE: GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES

4. SEISMIC LOADING:

B = ANGLE OF INTERNAL FRICTION = 37

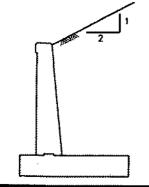
A = 0.17g (Max.)

 δ = angle of wall friction = 22

Kh = 0.085

Y = EFFECTIVE UNIT WEIGHT = 120 pcf

Kv = 0



CONSTRUCTION STANDARDS

CANTILEVER RETAINING WADENSE FOUNDATION SOILS,
LEVEL BACKFILL, SURCHARGE

DATE OF ISSUE
APRIL 2004
DRAWING NUMBER
305.3.0

							TAE	LE OF DIN	ENSIONS /	NO RENF	ORCING ST	EEL.					
	14.0	15.0	16,0	17.0	18.0	19.0	20.0	21,8	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0
The second secon	7.000	7.500	8.000	8.500	9.000	9,000	9,500	10.000	10.500	11,000	11.000	11,500	12.000	12.500	13.000	13.000	13.500
*	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2,000	2.000	2.000	2.000	2.000	2.500	2.500
4 4 A	2.500	2.500	2.500	2.500	3,000	3,000	3.000	3.000	3,500	3,500	3,500	4,000	4.000	4,000	4.500	4.500	4,500
B	2.500	2.583	2.667	2,750	2.833	2,917	3.000	3.083	3.167	3.250	3,333	3.417	3,500	3.583	3.667	3.708	3,792
Ç	2.000	2.417	2.833	3,250	3.167	3,083	3.500	3.917	3.833	4.250	4.167	4,083	4,500	4.917	4.833	4.792	5.208
		ļ					<u></u>										<u> </u>
	2.400	2.600	4.200	4,500	6.400	6,800	7.200	9,500	10.000	10.500	11.000	13.800	14.400	15.000	15.600	15,900	16.500
	1.000	1.000	1.000	1.250	1.250	1.250	1.500	1.917	1.917	2.500	2.500	2.500	3.157	4.083	4.083	3,167	4.083
N A STATE	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1,000	1.000	1.250	1.250	1,250	1.250	1.250	1.250
.	1.250	1,250	1.250	1,250	1.500	1.500	1.917	1.917	2,500	2.500	2.500	3.167	4.083	4.083	5,000	4.083	4,083
НООК	0,833	1.000	1.000	1.000	1.000	1.167	1.333	1.333	1.333	1.583	1.583	1,833	1.833	1.833	1.833	2.000	2.000
		C 40 40	C 640		C 40.40	7040	0.40.40	0.6040	0.65.40			40.0040	10.40.40	40 40 40	40.40.40	44 49 42	44 49 42
Abars	5@12	6@12	6@12	6@12	6@12	7@12	8@12	8@12	8@12	9@12	9@12	10 @ 12	10 @ 12	10@12	10@12	11 @ 12	11@12
B bars C bars	4@12	4@12	4@12	4@12	4@12	4 @ 12	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4@12 10@18	4@12 9@18	4 @ 12 10 @ 18
Doars	4 @ 18 4 @ 18	4@18 4@18	4@16 4@18	5 @ 18 4 @ 18	5 @ 18 4 @ 18	5 @ 18 4 @ 18	6@18 4@18	7@18 4@18	7@18 4@18	8 @ 18 4 @ 18	8 @ 18 4 @ 18	8 @ 18 5 @ 18	9 @ 18 5 @ 18	10 @ 18 5 @ 18	5@18	5@18	5 @ 18
Ebers	5@18	5@18	5@18	5@18	6@18	6@18	7@18	7@18	8@18	8@18	8@18	9@18	10 @ 18	10 @ 18	11@18	10 @ 18	10@18
										<u> </u>	V 65 1.0						
								Quar	tities of Ma	terials							
Stem Concrete (yd /ft)	0.9	0.9	1.1	1,2	1.3	1.4	1.5	1,6	1.7	1.8	2.0	2.1	2.2	2.4	2.5	2.6	2.7
Footing Concrete (yd ³ /ft)	0,5	0.6	0.6	0.6	0.7	0.7	0.7	0.7	9.8	0.8	0,8	0.9	0.9	0,9	1,0	1.2	1.3
Steel (lb/ft)	76	86	96	104	118	133	161	182	198	233	240	307	340	360	388	412	438
								Maximum :	Soll Bearing	Pressure							

Notes:

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1. All dimensions are in feet, unless specified otherwise.

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5491

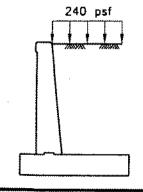
- 2. Specings of reinforcing bers are in inches.
- Designer must confirm design parameters with Geotechnical Engineer prior to selecting wall for site.

ASSUMED DESIGN PARAMETERS

5752

6018

DENSE FOUNDATION SOIL, LEVEL BACKFILL, SURCHARGE



Q_{mer} (pst)

4071

4328

- BACKFILL LOADING CONDITIONS:

4860

- LEVEL BACKFILL; 240 psf LIVE EOAD SURCHARGE,
- BACKFILL SOIL PROPERTIES:
 - TYPE: GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES
 - BACKFILLING STRUCTURES AND PIPES
 - 0 * ANGLE OF INTERNAL FRICTION * 37
 - δ = ANGLE OF WALL FRICTION = 2Z Y = EFFECTIVE UNIT WEIGHT = 120 pcf

3. FOUNDATION SOIL PROPERTIES:

5945

q = FACTORED BEARING CAPACITY = 9400 psf

6208

6917

6833

7090

7352

- FRICTION FACTOR = 0.57
- SLOWE * PERFORMANCE FACTOR FOR SLIDING * 0,80
- 4. SEISMIC LOADING:
- - A = 0.17g (Max.)
 - Kh = 0.085
 - Ky ≠ 0

- 5. REINFORCED CONCRETE:
- F_C = 4000 psi

7271

8079

8332

F_y = 60000 psi

STAN	CONS	MASS
DARDS	ISTRUCTION	HIGHWAY

ILEVER LOOSE FOUNDATION RETAINING

SLOPING

BACKFILL

SOILS,

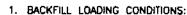
							TAL	SLE OF DIM	ENSIONS /	WD RENF	ORCING ST	TEEL					
	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21,0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0
W	10.000	11.000	11.500	13.000	14.000	15.000	15.500	16.500	17.500	18.500	20.000	20,500	22.000	23.000	24.000	25.000	26.000
ан карай т у	2.000	2.000	2.000	2.500	2.500	3.000	3.000	3.500	3.500	4.000	4,000	4,500	4,500	5.000	5.500	5.500	6.000
20 € 20 2 4	1,000	1,000	1,000	2.000	2.500	2.500	2.500	3,000	3.500	4,000	5,000	5.000	6,000	6,500	7.000	7.500	8.000
8	2.500	2.583	2.667	2.708	2.792	2.833	2.917	2,958	3.042	3,083	3.167	3.208	3.292	3.333	3,375	3,458	3.500
	6,500	7.417	7.833	8.292	8.708	9.667	10,083	10.542	10.958	11.417	11.833	12.292	12.708	13.167	13.625	14.042	14.500
	3,600	3,900	5.600	5.800	6.200	6.400	8,500	8.750	9,250	9,500	10.000	10.250	10,750	13,200	13,500	14.100	14.400
W	4.083	5.000	5,000	5,000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5,000	5.000	5.000	5,000	5,000	5,000
(1.4 (a) (a) N	1.000	1.250	1.250	1.250	1.500	1.500	1.500	1,917	1,917	1.917	1,917	1.917	2,500	2,500	3.167	3.167	3,167
P	1.000	1.000	1.000	1.000	1.250	1.000	1.250	1.250	1,500	1.500	1.917	1.917	2,500	2.500	2.500	3.167	3.167
HOOK	1.000	1.167	1.167	1.167	1.333	1.333	1.583	1.583	1.833	1.833	2.000	2.000	2.000	1.583	1.583	1.583	1.583
	~~~		7.60.40	7 40 40	0.00.40		N 44 4 N	0.00.40		40.640	44 40 40	44 40 40	44 40 40	000	2.43.6	0.60.6	0.60.6
A bers B bars	6@12	7@12	7 @ 12	7@12	8@12	8@12	9@12	9@12	10@12	10@12	11 @ 12 4 @ 12	11 @ 12 4 @ 12	11@12	9@6 4@12	9 @ 6 4 @ 12	9 @ 6 4 @ 12	9 @ 6 4 @ 12
Chars	4 @ 12 10 @ 18	4@12 11@15.5	4@12 11@13	4@12 11@14.5	4@12 11@12.5	4@12 11@11.5	4 @ 12 11 @ 18	4@12 11@10.5	4 @ 12 11 @ 9	4@12 11@9	11@8	11 @ 8.5	4@12 11@7.5	11 @ 7.5	11 @ 7.5	11 @ 6.5	11 @ 6.5
D bars	4 @ 18	5@18	5@18	5@18	6@18	6 @ 18	6@18	7@18	7 @ 18	7@18	7 @ 16	7@16	8 @ 18	8 60 18	9@18	9 (2) 18	9 @ 18
E hars	4 @ 18	4@18	4@18	4 @ 18	5 @ 18	4 @ 18	5@18	5@18	6@18	6 @ 18	7 @ 16	7@16	8 @ 18	8 @ 18	8 @ 18	9 @ 18	9 @18
								Quent	ities of Ma	teriais							
Stern Concrete (ya /ft)	0.9	1.0	1.1	1.1	1.2	1,3	1,4	1,4	1.6	1.6	1.7	1.8	1.9	2.0	2.2	2.2	2.2
Footing Concrete (yd */fi)	0.7	0.8	0.9	1.2	1.3	1.7	1,7	2.1	2.3	2.7	3.0	3.4	3.7	4.3	4.9	5.1	5.8
Steel (lb/ft)	126	158	173	189	219	309	351	379	422	440	500	516	557	588	625	653	654
								Maximum S	oil Bearing	j Pressure							
Q _{mas} (psf)	4918	5231	5737	5064	49 <del>9</del> 8	5371	5816	5814	5771	5807	5387	5847	5473	5567	5667	5687	57 <del>9</del> 7

#### Notes:

- 1. All dimensions are in feet, unless specified otherwise.
- 2. Spacings of reinforcing bers are in inches.
- 3. Designer must confirm design parameters with Geotechnical Engineer prior to selecting wall for site.

# ASSUMED DESIGN PARAMETERS

LOOSE FOUNDATION SOIL, SLOPING BACKFILL



3. FOUNDATION SOIL PROPERTIES:

5. REINFORCED CONCRETE:

q = FACTORED BEARING CAPACITY = 6000 psf

w 4000 psi

2H:3V SLOPING BACKFILL

FRICTION FACTOR # 0.50

F_V = 60000 psi

2. BACKFILL SOIL PROPERTIES:

Ø = PERFORMANCE FACTOR FOR SLIDING № 0.80

TYPE: GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES

4. SEISMIC LOADING:

 $\theta$  = ANGLE OF INTERNAL FRICTION = 37

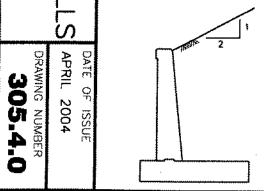
Kh # 0.085

A = 0.17g (Max.)

 $\delta$  * ANGLE OF WALL FRICTION * 22'

γ = EFFECTIVE UNIT WEIGHT = 120 pcf

Kv = 0



STANDARDS	CONSTRUCT	MASSSHIGH
S		GHWAY

NITLEVER RETAINING W.

LOOSE FOUNDATION SOILS,

LEVEL BACKFILL, SURCHARGE

DRAWING NUMBER
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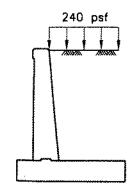
						·	TARIFO	F DIMENSI	ONS AND S	FINEORY	VG STEEL	······································					********
H	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0	27,0	28.0	29.0	30.0
w	7.500	8,000	8.000	8.500	9,000	9,500	10.000	10,500	11,000	11.500	12,000	13.000	13.500	14.000	15.000	15.500	16.00
<i>†</i>	2,000	2,000	2,000	2,000	2.000	2.000	2,000	2.000	2.000	2.000	2.000	2.000	2.000	2.500	2.500	2.500	2.500
A	1.500	1.500	1.750	2,000	2.500	2.500	2.500	3,000	3.000	3.500	3.750	4.250	4.500	5.000	5.500	5,500	6.00
8	2.500	2.583	2.667	2.750	2.833	2.917	3.000	3.083	3,157	3.250	3,333	3.417	3.500	3.542	3.625	3.750	3.87
C .	3.500	3.917	3.583	3.750	3.667	4.083	4.500	4.417	4.833	4.750	4.917	5.333	5.500	5.458	5.875	6.250	6.12
								l									
L	2.400	2.600	4.200	4.500	6.400	6.800	7.200	9.500	10.000	10.500	11.000	11.500	14.400	14.700	15,300	15.900	16.50
M	1.250	1.500	1.500	1.500	1.500	1.917	2,500	2.500	3.167	3.187	3.167	4.083	4.083	3.167	4.083	5.000	5.00
N	1.000	1,000	1,000	1,000	1.000	1.000	1.000	1,000	1,250	1,250	1.250	1.250	1,500	1,250	1.500	1.500	1,50
Р	1,000	1,000	1.000	1.000	1.250	1.250	1,500	1,917	1.917	2.500	2.500	3.167	4.083	3.167	4.083	4.083	5.00
HOOK	0.833	0.833	1.000	1,000	1.167	1.167	1.167	1.333	1.333	1.583	1.583	1.583	1,833	1.833	2.000	2.000	2.00
A bars	5 <b>@</b> 12	5@12	6@12	6 @ 12	7@12	7@12	7@12	8@12	8 @ 12	9 @ 12	9@12	9@12	10@12	10 @ 12	11 @ 12	11 @ 12	11@
8 bars	4@12	4@12	4@12	4@12	4 @ 12	4@12	4@12	4 @ 12	4 @ 12	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4@1
Chers	5@18	6@18	6@18	6@18	6@18	7@18	8@18	8 @ 18	9 @ 18	9 @ 18	9 @ 18	10@18	10@16	9@16	10 @ 18	11@18	11 @
D bars	4@18	4 @ 18	4@18	4 @ 18	4@18	4@18	4@18	4@18	5@18	5@18	5@18	5@18	6@18	5@18	6@18	6@18	6@1
E bers	4@18	4@18	4@18	4@18	5@18	5@18	6@18	7@18	7@18	8@18	8@18	9@18	10@18	9@18	10@18	10 @ 18	11@1
								Quera	ities of Ma	terials							
Stem Concrete (yd 3/ft)	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	2.0	2.1	2.1	2.3	2.4	2.6	2.7
Footing Concrete (yd 1/11)	0.6	0.6	0.6	0.6	0.7	<b>Q.7</b>	0.7	0.8	0.8	0.9	0,9	1.0	1.0	1.3	1.4	1,4	1.5
Steel (Ib/ft)	79	86	101	106	130	141	157	191	211	246	257	287	365	343	435	463	492
								Meximum :									
Q _{max} (psf)	4318	4614	5111	5210	5133	5412	5693	5616	5893	5824	5929	5558	5670	5733	5440	5695	5687

#### Notes:

- All dimensions are in feet, unless specified otherwise.
- 2. Specings of reinforcing bars are in inches.
- Designer must confirm design parameters with Geotechnical Engineer prior to selecting wall for site.

# ASSUMED DESIGN PARAMETERS

LOOSE FOUNDATION SOIL, LEVEL BACKFILL, SURCHARGE



- BACKFILL LOADING CONDITIONS:
  - promise consider continuing
  - LEVEL BACKFILL; 240 psf LIVE LOAD SURCHARGE.
- 2. BACKFILL SOIL PROPERTIES:
  - TYPE: GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES
  - 0 = ANGLE OF INTERNAL FRICTION = 37
  - 8 = ANGLE OF WALL FRICTION = 22"
  - Y = EFFECTIVE UNIT WEIGHT = 120 pcf

- 3. FOUNDATION SOIL PROPERTIES:
  - q = FACTORED BEARING CAPACITY = 6000 psf
  - **4** ... .....
  - FRECTION FACTOR = 0.5
  - # PERFORMANCE FACTOR FOR SLIDING = 0.80
- 4. SEISMIC LOADING:
- - A = 0.17g (Max.)
  - Kh # 0.085
  - K+ # 0

5. REINFORCED CONCRETE:

F_C = 4000 psi

Fy ≈ 60000 psi

SLOPING

BACKFILL

						·····	TAI	LE OF DIM	ENSIONS /	AND REINE	ORCING S	EEL				.,	
	14.0	15.0	16.0	17.0	18.0	19.0	20,0	21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0
	8,500	9.000	9.000	9.500	10,000	10.500	11.000	11.500	12.000	13.000	13,500	14.000	14,500	15.000	15.500	16.000	16,500
*	2.000	2.000	2.000	2.000	2.000	2,000	2.000	2.000	2.500	2.500	2.500	2.500	2.500	2.500	3.000	3,000	3.500
	1.500	2.000	2.500	3.000	3.000	3,500	3.500	4,000	4,500	4.500	4.500	5,000	5,000	5.500	5,500	6,000	6.000
В	2.500	2.583	2667	2.750	2.833	2.917	3,000	3.083	3.125	3.208	3.292	3.375	3,458	3.542	3,583	1667	3.708
	4,500	4,417	3.833	3.750	4.167	4.083	4,500	4.417	4,375	5.292	5.708	5.625	6.042	5.958	6,417	6.333	6.792
<u></u>							<u> </u>				·······			<u></u>			
	3.600	3.900	5.600	6.000	8.000	8.500	9.000	11,400	11.700	12.300	12.900	13.500	16.450	17.150	17.500	18.200	18.550
*	1.917	1,917	1.917	1.917	1,917	1.917	2.500	2.500	1,917	3.167	4,083	4,083	5,000	5.000	5.000	5.000	5.000
N	1,000	1,000	1.000	1,000	1,000	1,000	1.000	1.250	1.000	1.250	1.250	1.250	1.250	1.250	1.500	1.250	1.500
P	1,000	1,000	1.250	1,917	1,917	2,500	2,500	3.167	3.167	3.167	4.083	4.083	5.000	5.000	5.000	5.000	5.000
HOOK	1.000	1.167	1.167	1,333	1,333	1.583	1,583	1.833	1.833	2.000	2.000	1.583	1.583	1.833	1,833	1,833	1.833
4.000		7.40.20	7 40 40	0.040	0.6040	0.00.40		10.40.40	40.00.40	44 40 40	***	5.40.0	0.00	40.45.6	40.40 C	10.00	40.00
A bers	6@12	7@12	7@12	8@12	8@12	9 @ 12	9 @ 12	10@12	10@12	11@12	11 @ 12	9@6	9@6	10@6	10@6	10.026	10 @ 6
B bers	4 @ 12	4@12	4@12	4@12	4 @ 12	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4@12
Chars	7@18	7@18	7@18	7@18	7@18	7@17	8 @ 18	8@18	7@17	9@18	10@18	10@18	11 @ 18	11 @ 18	11 @ 18	11 @ 18	11 @ 18
D bars	4@18	4@18	4@18	4@18	4@18	4@18	4 @ 18	5@18	4@18	5@18	5@18	5@17	5@18	5@16	6@18	5@15	6@17
Ebas	4@18	4@18	5@18	7 @ 18	7@18	8@18	8 (2) 18	9@18	9@18	9@18	10@18	10@17	11@18	11 @ 16	11 @ 18	11 @ 15	11 @ 17
								Quen	ities of Ma	terials							
Stem Concrete (yd /ft)	0.9	0.9	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.2	2.3	2.4	2.5	2.7
Footing Concrete (yd ³ /ft)	0.6	0.7	0.7	0.7	9.7	0.8	0.8	0.9	1.1	1.2	1.3	1.3	1.3	1.4	1.7	1.8	2.1
Steel (Ib/ft)	98	120	125	148	164	197	213	272	276	342	379	382	446	503	543	558	580
			₹.					Meximum S	Bali Bearing	g Pressure							
Q _{mex} (psf)	5123	5161	5481	5530	6053	6103	6626	6677	6838	7053	7562	7625	8134	8197	8802	8870	9475

#### Notes:

- 1. All dimensions are in feet, unless specified otherwise.
- Specings of reinforcing bers are in inches.
- 3. Designer must confirm design parameters with Geotechnical Engineer prior to selecting well for site.

# ASSUMED DESIGN PARAMETERS

#### ROCK FOUNDATION, SLOPING BACKFILL

- 1. BACKFILL LOADING CONDITIONS:
- 3. FOUNDATION SOIL PROPERTIES:

FRICTION FACTOR = 0.70

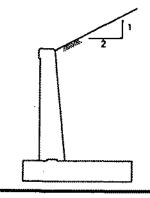
5. REINFORCEO CONCRETE:

2H:1V SLOPING BACKFILL

- q = FACTORED BEARING CAPACITY = 20000 psf
- F_C * 4000 psi F_V = 60000 psi

2. BACKFILL SOIL PROPERTIES:

- # PERFORMANCE FACTOR FOR SUDING = 0.80
- TYPE: GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES
- 4. SEISMIC LOADING:
- 0 = ANGLE OF INTERNAL FRICTION = 37
- A = 0.17g (Max.)
- $\delta$  = ANGLE OF WALL FRICTION = 22
- Kh = 0.085
- Y = EFFECTIVE UNIT WEIGHT = 120 pcf
- Ky = 0



STANDARDS	CONSTRUCTION	MASSHIGHWAY
		2

ANTILEVER RETAINING W
ROCK FOUNDATION,
LEVEL BACKFILL, SURCHARGE

DRAWING NIBARE	APRIL 2004				

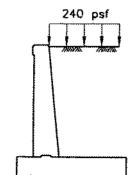
<b>#</b>							TAE	BLE OF DIM	Ensions /	and reinf	ORCING ST	Teel .					
	14.0	15.0	16.0	17.0	18,0	19.0	20.0	21.0	22.0	23.0	24.0	25,0	26,0	27.0	28.0	29.0	30.0
Yana <b>W</b> ana a Mana	7.000	7.500	8,000	8.500	9.000	9.000	9.500	10.000	10.500	11.000	11.000	11,500	12.000	12,500	13.000	13.000	13.500
	2.000	2,000	2.000	2,000	2,000	2.000	2.000	2.000	2,000	2,000	2.000	2.000	2.000	2.000	2.000	2.500	2.500
ili mara Aktoria	2.500	2,500	2.500	2.500	3,000	3.000	3,000	3,000	3,500	3.500	3.500	4,000	4,000	4,000	4.600	4,500	4.500
[[보이다 소 <b>를</b> 보는 하는 일본]	2.500	2.583	2.667	2.750	2.833	2,917	3,000	3.083	3,167	3,250	3.333	3.417	3.500	3.583	3.667	3.708	3.792
¢	2.000	2.417	2.833	3.250	3.167	3.083	3.500	3.917	3.833	4.250	4.167	4.083	4.500	4.917	4.833	4.792	5.208
	<u> </u>														<u> </u>	<u> </u>	
	2.400	2.600	4.200	4.500	6.400	6.800	7.200	9.500	10.000	10.500	11.000	13.800	14.400	15.000	15.600	15,900	16,500
<b>M</b>	1,000	1,000	1,000	1.250	1.250	1.250	1.500	1.917	1.917	2.500	2.500	2.500	3.167	4,083	4,083	3,167	4.083
eri sasa <b>N</b> asarah	1,000	1,000	1,000	1,000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.250	1.250	1.250	1,250	1.250	1.250
<b></b>	1.250	1.250	1.250	1.250	1.500	1.500	1.917	1.917	2.500	2.500	2.500	3.167	4.083	4,083	5.000	4.083	4,093
HOOK	0.833	1.000	1.000	1.000	1.000	1.167	1.333	1.333	1.333	1.583	1.583	1.833	1.833	1.833	1.833	2,000	2.000
									<u></u>					· · · · · · · · · · · · · · · · · · ·			
A bars	5 @ 12	6@12	6 @ 12	6@12	6@12	7@12	8@12	8@12	8@12	9@12	9@12	10 @ 12	10 @ 12	10@12	10 @ 12	11 @ 12	11@1
8 bars	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4@12	4 @ 12	4@12	4@12	4@12	4@12	4@12	4@12
C bars	4@18	4@18	4@16	5@18	5@18	5@18	6@18	7@18	7@18	8@18	8@18	8@18	9@18	10@18	10@18	9@18	10@18
D bers	4@18	4@18	4@18	4 @ 18	4@18	4@18	4@18	4@18	4@18	4@18	4@18	5@18	5@18	5@18	5@18	5@18	5@18
E bars	5@18	5@18	5@18	5@18	6@18	6@18	7@18	7@18	8@18	8@18	8@18	9@18	10 @ 18	10@18	11 @ 18	10@18	10@18
								Quant	ities of Ma	terlais							
Stern Concrete (yd 7ft)	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	2.0	2.1	2.2	2.4	2.5	2.6	2.7
Footing Concrete (yd ³ /ft)	0.5	0.6	0.6	0.6	0.7	0.7	0.7	0.7	8.0	8,0	0.8	0.9	0.9	0.9	1.0	1.2	1.3
Steel (lb/ft)	76	85	96	104	118	133	176	182	198	233	240	307	340	360	388	412	438
Maximum Soll Bearing Pressure																	
Q _{max} (ost)	4071	4328	4591	4860	4811	5491	5752	6018	5945	6208	6917	6833	7090	7352	7271	8079	8332

#### Notes:

- All dimensions are in feet, unless specified otherwise.
- 2. Spacings of reinforcing bars are in inches.
- Designer must confirm design parameters with Geotechnical Engineer prior to selecting wall for site.

# ASSUMED DESIGN PARAMETERS

## ROCK FOUNDATION, LEVEL BACKFILL, SURCHARGE



- 1. BACKFILL LOADING CONDITIONS:
- 3. FOUNDATION SOIL PROPERTIES:

FRICTION FACTOR = 0.70

5. REINFORCED CONCRETE:

LEVEL BACKFILL; 240 psf LIVE LOAD SURCHARGE.

- q = FACTORED BEARING CAPACITY = 20000 psf
- F_C = 400D psi F_V = 50000 psi

BACKFILL SOIL PROPERTIES:

TYPE: GRAVEL BORROW FOR

- 9 = PERFORMANCE FACTOR FOR SLIDING = 0.80
- BACKFILLING STRUCTURES AND PIPES
- 4. SEISMIC LOADING:
- 0 = ANGLE OF INTERNAL FRICTION = 37
- A = 0.17g (Max.)
- $\delta$  * ANGLE OF WALL FRICTION * 22
- Kh = 0.085
- Y = EFFECTIVE UNIT WEIGHT = 120 pcf
- Ky # 0