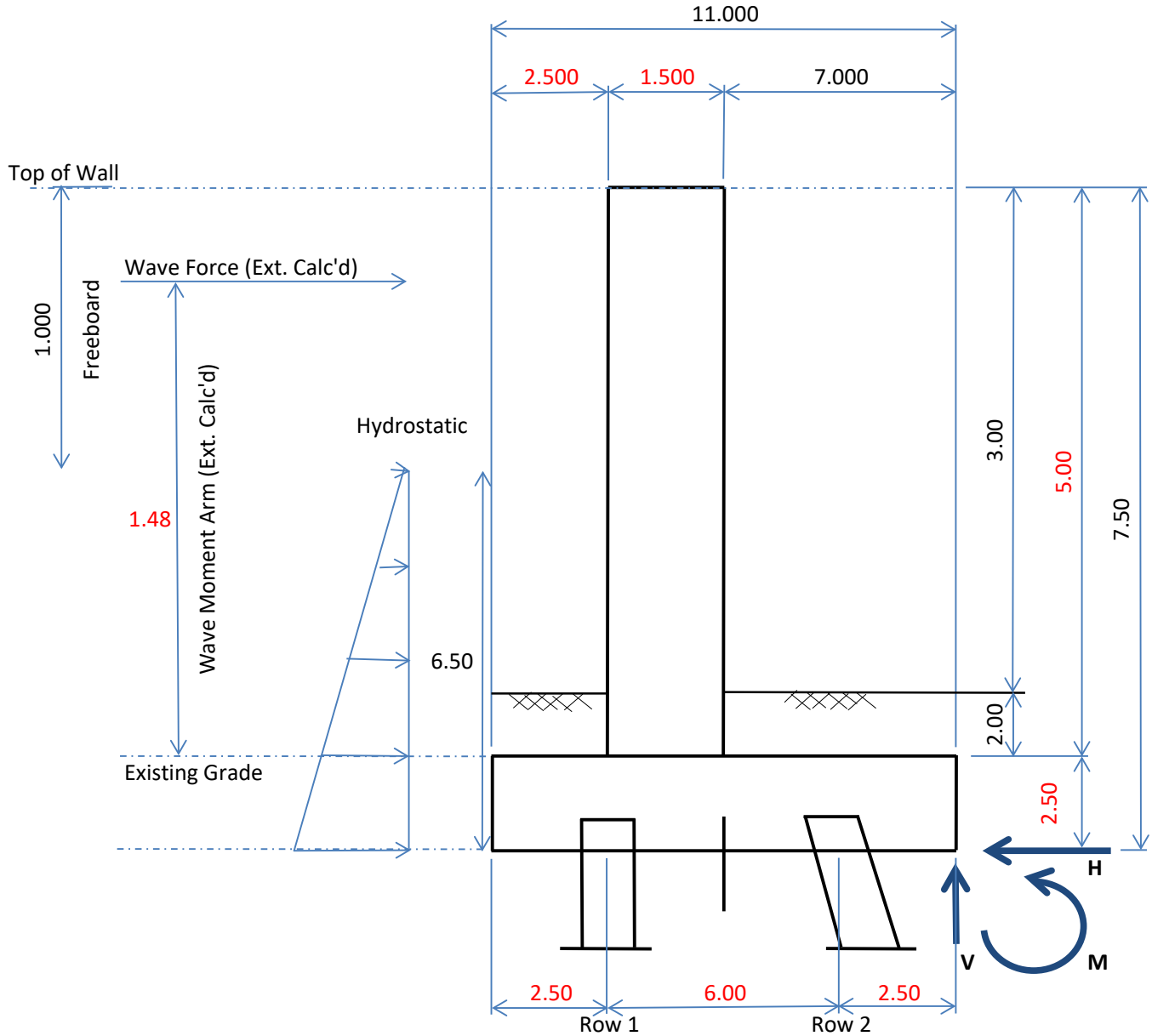


3FT EXPOSED WALL HEIGHT W/ 2FT WAVE

Consider 1 ft strip wall
Not to Scale

Approximate CY Concrete per 1ft Strip Wall = 35

Approximate CY Backfill per 1ft Strip Wall = 14



Boston CSRM
Flood Wall

Prepared by: JTD
 Checked by: MSA

Date: 9/1/2025
 Date: 6/4/2026

PILE FORCES FOR SERVICE STAGES

Concrete Unit Weight =	0.150	Kcf
Salt Water Unit Weight =	0.064	Kcf
Soil Unit Weight =	0.125	Kcf
Wave Load on Wall - Top (p2) =	0.000	Ksf
Wave Load on Wall - Mid (p1) =	0.000	Ksf
Wave Load on Wall - Bot (p3) =	0.000	Ksf
Wave Load on Wall - Pressure =	0.339	kip/ft

	LF	L _v	V	M _v	L _H	H	M _H
LC Load Description	---	ft	Kip	Kip.ft	ft	Kip	Kip.ft
Stem Weight	1.000	7.750	1.125	8.719			
Footing Weight	1.000	5.500	4.125	22.688			
V Soil Weight - Front	1.000	9.750	0.625	6.094			
Soil Weight - Back	1.000	3.500	1.750	6.125			
Subtotal	---	---	7.625	43.625			
H Hydrostatic Pressure	1.000				2.167	1.354	2.934
H Wave Pressure	1.000				3.983	0.339	1.349
H Wave Pressure (1)	1.000				3.000	0.000	0.000
H Wave Pressure (2)	1.000				2.500	0.000	0.000
H Wave Pressure (3)	1.000				2.500	0.000	0.000
Load Comb - SERVICE IV			7.625	43.625		1.693	4.283

Resultant Forces at Neutral Axis:

V =	7.625	kips
H =	1.693	kips
M =	-0.672	kips

Row 1 Pile Spacing =	10.000	ft		
Row 1 Pile Area per LF - A ₁ =	0.100	Piles	d ₁ =	3.429 ft
Row 2 Pile Spacing =	7.500	ft		
Row 2 Pile Area per LF - A ₂ =	0.133	Piles	d ₂ =	-2.571 ft
Dist. From NA to Toe -D =	5.071	ft		
Total Pile Area per LF - A =	0.233	Piles		
Moment of Inertia $\Sigma A_i d_i^2$ - I =	2.057	Pile*ft ²		

Row 1 Axial Pile Load - P1 =	-33.799	kips per Pile	(+ Tension)	Less Than ~30 kip/Pile?
Row 1 Axial Pile Load - P1 =	-3.380	kips per ft		NO
Row 2 Axial Pile Load - P2 =	-31.838	kips per Pile	(- Compression)	NO
Row 2 Axial Pile Load - P2 =	-4.245	kips per ft		
Shear on Pile Head =	7.255	kips per Pile		YES

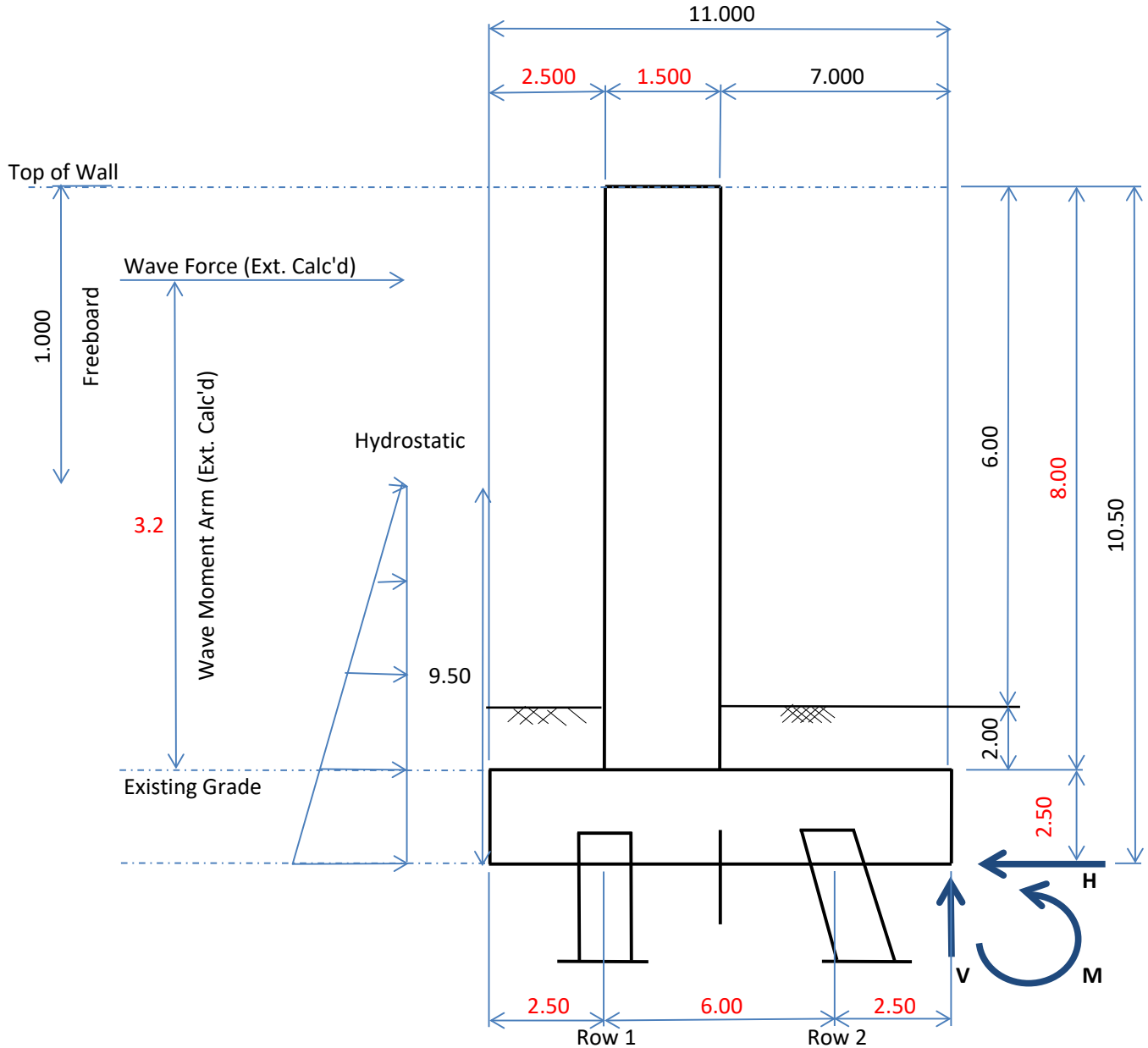
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6FT EXPOSED WALL HEIGHT W/ 2FT WAVE

Consider 1 ft strip wall
Not to Scale

Approximate CY Concrete per 1ft Strip Wall = 40

Approximate CY Backfill per 1ft Strip Wall = 14



PILE FORCES FOR SERVICE STAGES

Concrete Unit Weight =	0.150	Kcf
Salt Water Unit Weight =	0.064	Kcf
Soil Unit Weight =	0.125	Kcf
Wave Load on Wall - Top (p2) =	0.000	Ksf
Wave Load on Wall - Mid (p1) =	0.000	Ksf
Wave Load on Wall - Bot (p3) =	0.000	Ksf
Wave Load on Wall - Pressure =	0.841	kip/ft

	LF	L _v	V	M _v	L _H	H	M _H
LC Load Description	---	ft	Kip	Kip.ft	ft	Kip	Kip.ft
Stem Weight	1.000	7.750	1.800	13.950			
Footing Weight	1.000	5.500	4.125	22.688			
V Soil Weight - Front	1.000	9.750	0.625	6.094			
Soil Weight - Back	1.000	3.500	1.750	6.125			
Subtotal	---	---	8.300	48.856			
H Hydrostatic Pressure	1.000				3.167	2.893	9.160
H Wave Pressure	1.000				5.704	0.841	4.799
H Wave Pressure (1)	1.000				3.000	0.000	0.000
H Wave Pressure (2)	1.000				2.500	0.000	0.000
H Wave Pressure (3)	1.000				2.500	0.000	0.000
Load Comb - SERVICE IV			8.300	48.856		3.734	13.958

Resultant Forces at Neutral Axis:

V =	8.300	kips
H =	3.734	kips
M =	2.452	kips

Row 1 Pile Spacing =	10.000	ft		
Row 1 Pile Area per LF - A ₁ =	0.100	Piles	d ₁ =	4.000 ft
Row 2 Pile Spacing =	5.000	ft		
Row 2 Pile Area per LF - A ₂ =	0.200	Piles	d ₂ =	-2.000 ft
Dist. From NA to Toe -D =	4.500	ft		
Total Pile Area per LF - A =	0.300	Piles		
Moment of Inertia $\Sigma A_i d_i^2 - I =$	2.400	Pile*ft ²		

Row 1 Axial Pile Load - P1 =	-23.580	kips per Pile	(+ Tension)	Less Than ~30 kip/Pile?
Row 1 Axial Pile Load - P1 =	-2.358	kips per ft		YES
Row 2 Axial Pile Load - P2 =	-29.710	kips per Pile	(- Compression)	YES
Row 2 Axial Pile Load - P2 =	-5.942	kips per ft		
Shear on Pile Head =	12.446	kips per Pile		YES

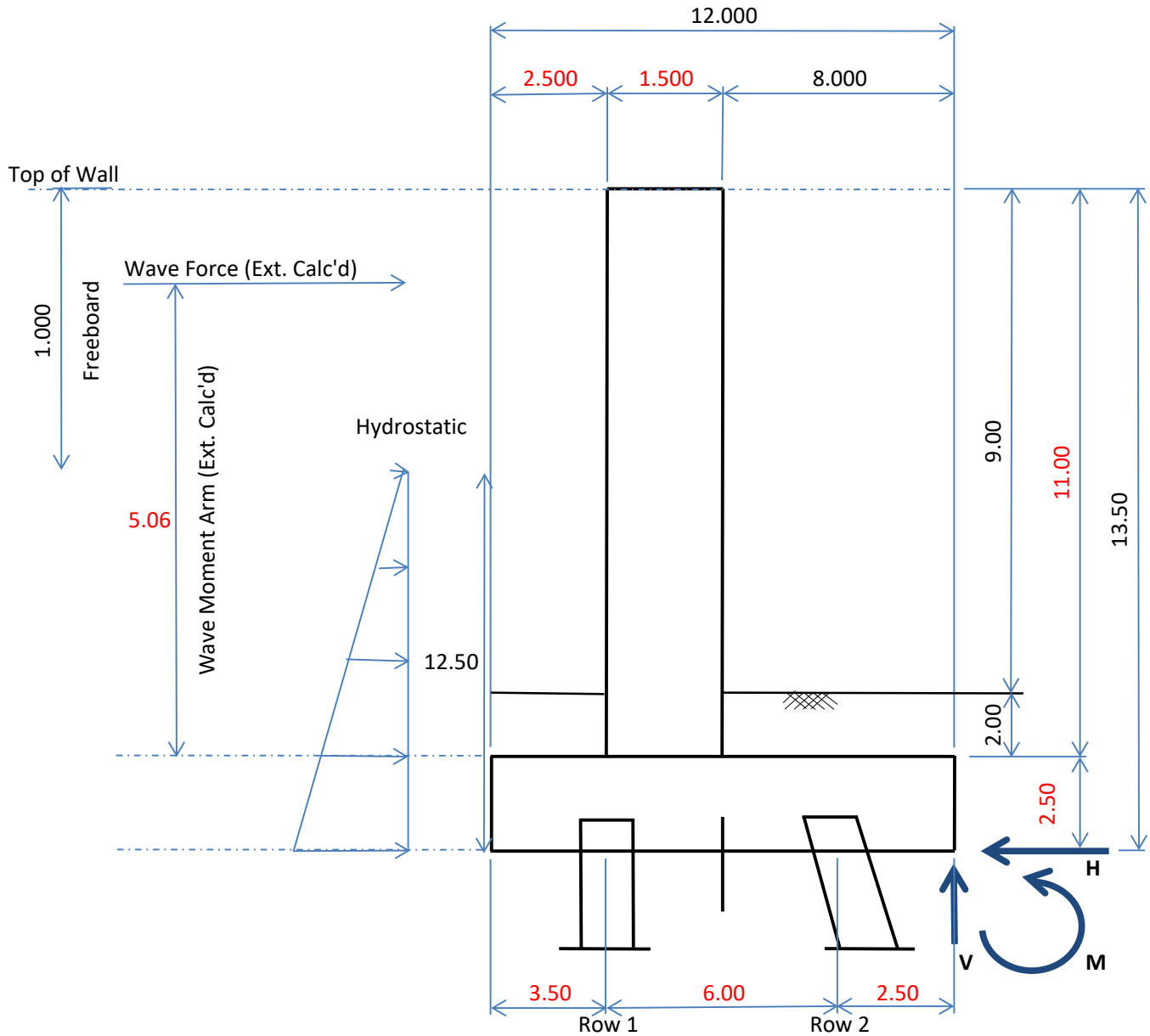
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9FT EXPOSED WALL HEIGHT W/ 2FT WAVE

Consider 1 ft strip wall
Not to Scale

Approximate CY Concrete per 1ft Strip Wall = 47

Approximate CY Backfill per 1ft Strip Wall = 16



PILE FORCES FOR SERVICE STAGES

Concrete Unit Weight =	0.150	Kcf
Salt Water Unit Weight =	0.064	Kcf
Soil Unit Weight =	0.125	Kcf
Wave Load on Wall - Top (p2) =	0.000	Ksf
Wave Load on Wall - Mid (p1) =	0.000	Ksf
Wave Load on Wall - Bot (p3) =	0.000	Ksf
Wave Load on Wall - Pressure =	0.996	kip/ft

9' Height Seemingly
inflection point for 2 versus
3 pile rows

	LF	L _v	V	M _v	L _H	H	M _H
LC Load Description	---	ft	Kip	Kip.ft	ft	Kip	Kip.ft
Stem Weight	1.000	8.750	2.475	21.656			
Footing Weight	1.000	6.000	4.500	27.000			
V Soil Weight - Front	1.000	10.750	0.625	6.719			
Soil Weight - Back	1.000	4.000	2.000	8.000			
Subtotal	---	---	9.600	63.375			
H Hydrostatic Pressure	1.000				4.167	5.008	20.866
H Wave Pressure	1.000				7.560	0.996	7.531
H Wave Pressure (1)	1.000				3.000	0.000	0.000
H Wave Pressure (2)	1.000				2.500	0.000	0.000
H Wave Pressure (3)	1.000				2.500	0.000	0.000
Load Comb - SERVICE IV			9.600	63.375		6.004	28.397

Resultant Forces at Neutral Axis:

V =	9.600	kips
H =	6.004	kips
M =	8.222	kips

Row 1 Pile Spacing =	10.000	ft
Row 1 Pile Area per LF - A ₁ =	0.100	Piles
Row 2 Pile Spacing =	5.000	ft
Row 2 Pile Area per LF - A ₂ =	0.200	Piles
Dist. From NA to Toe -D =	4.500	ft
Total Pile Area per LF - A =	0.300	Piles
Moment of Inertia $\sum A_i d_i^2$ - I =	2.400	Pile*ft ²

Row 1 Axial Pile Load - P1 =	-18.296	kips per Pile	(+ Tension)
Row 1 Axial Pile Load - P1 =	-1.830	kips per ft	
Row 2 Axial Pile Load - P2 =	-38.852	kips per Pile	(- Compression)
Row 2 Axial Pile Load - P2 =	-7.770	kips per ft	
Shear on Pile Head =	20.013	kips per Pile	

Less Than ~30 kip/Pile?

YES

NO

YES

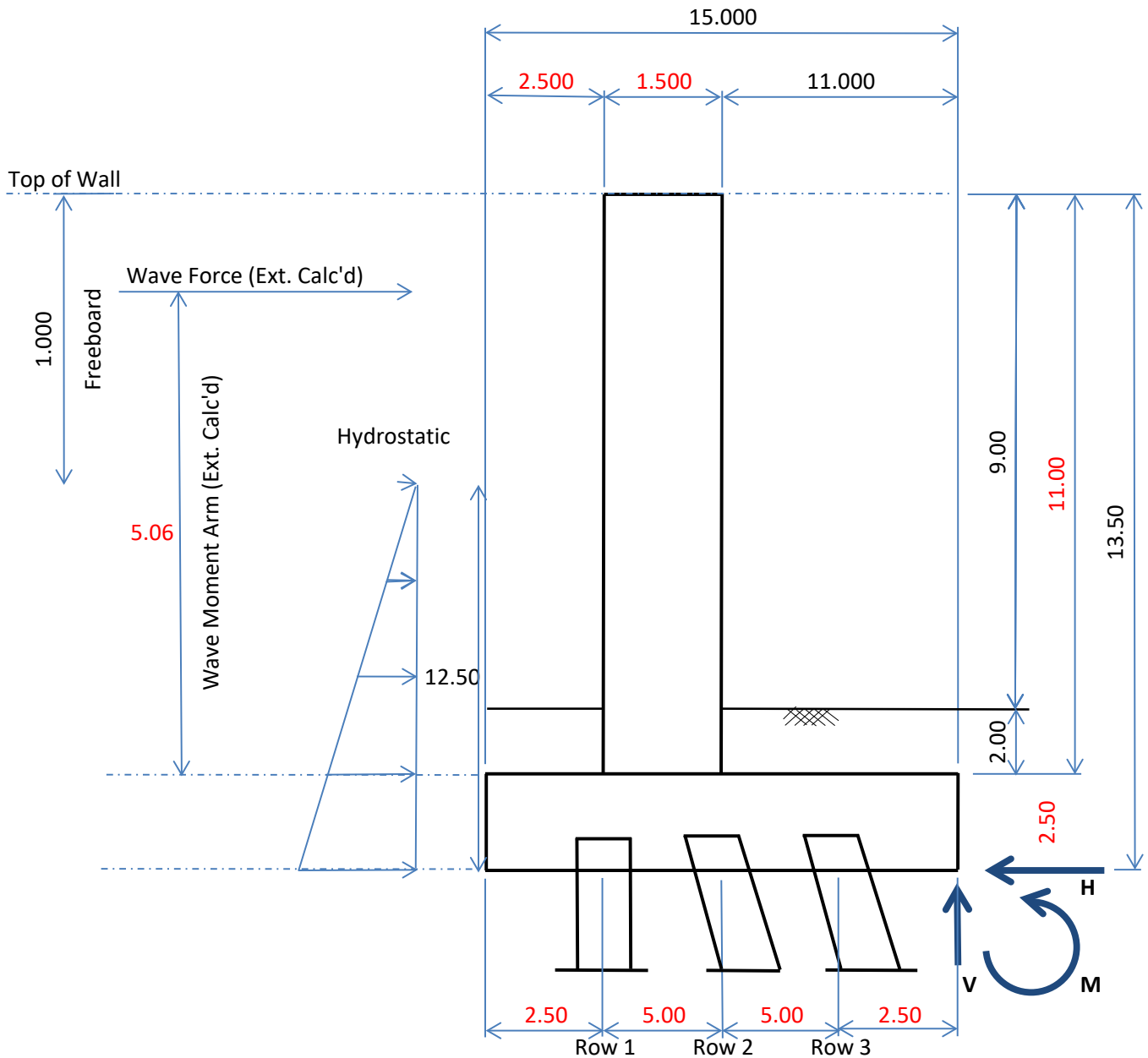
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9FT EXPOSED WALL HEIGHT W/ 2FT WAVE

Consider 1 ft strip wall
Not to Scale

Approximate CY Concrete per 1ft Strip Wall = 54

Approximate CY Backfill per 1ft Strip Wall = 22



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Boston CSRM
Flood Wall

Prepared by: JTD
Checked by: MSA

Date: 9/1/2025
Date: 6/4/2026

PILE FORCES FOR SERVICE STAGES

Concrete Unit Weight =	0.150	Kcf
Salt Water Unit Weight =	0.064	Kcf
Soil Unit Weight =	0.125	Kcf
Wave Load on Wall - Top (p2) =	0.000	Ksf
Wave Load on Wall - Mid (p1) =	0.000	Ksf
Wave Load on Wall - Bot (p3) =	0.000	Ksf
Wave Load on Wall - Pressure =	0.996	kip/ft

9' Height Seemingly
inflection point for 2 versus
3 pile rows

	LF	L _v	V	M _v	L _H	H	M _H
LC Load Description	---	ft	Kip	Kip.ft	ft	Kip	Kip.ft
Stem Weight	1.000	11.750	2.475	29.081			
Footing Weight	1.000	7.500	5.625	42.188			
V Soil Weight - Front	1.000	13.750	0.625	8.594			
Soil Weight - Back	1.000	5.500	2.750	15.125			
Subtotal	---	---	11.475	94.988			
H Hydrostatic Pressure	1.000				4.167	5.008	20.866
H Wave Pressure	1.000				7.560	0.996	7.531
H Wave Pressure (1)	1.000				3.000	0.000	0.000
H Wave Pressure (2)	1.000				2.500	0.000	0.000
H Wave Pressure (3)	1.000				2.500	0.000	0.000
Load Comb - SERVICE IV			11.475	94.988		6.004	28.397

Resultant Forces at Neutral Axis:

V =	11.475	kips
H =	6.004	kips
M =	5.128	kips

Row 1 Pile Spacing =	10.000	ft
Row 1 Pile Area pet LF - A ₁ =	0.100	Piles
Row 2 Pile Spacing =	10.000	ft
Row 2 Pile Area pet LF - A ₂ =	0.100	Piles
Row 3 Pile Spacing =	5.000	ft
Row 3 Pile Area pet LF - A ₃ =	0.200	Piles
Dist. From NA to Toe -D =	6.250	ft
Total Pile Area pet LF - A =	0.400	Piles
Moment of Inertia $\sum A_i d_i^2$ - I =	6.875	Pile*ft ²

Less Than ~30 kip/Pile?

Row 1 Axial Pile Load - P1 = -24.025 kips per Pile (+ Tension)

YES

Row 1 Axial Pile Load - P1 = -2.403 kips per ft

Row 2 Axial Pile Load - P2 = -27.755 kips per Pile (- Compression)

YES

Row 2 Axial Pile Load - P2 = -5.551 kips per ft

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Pile

USACE, New England District

Boston CSRM
Flood Wall

Prepared by: JTD
Checked by: MSA

Date: 9/1/2025
Date: 6/4/2026

Row 3 Axial Pile Load - P3 = -31.485 kips per Pile
Row 3 Axial Pile Load - P3 = -5.038 kips per ft
Shear on Pile Head = 15.010 kips per Pile

NO

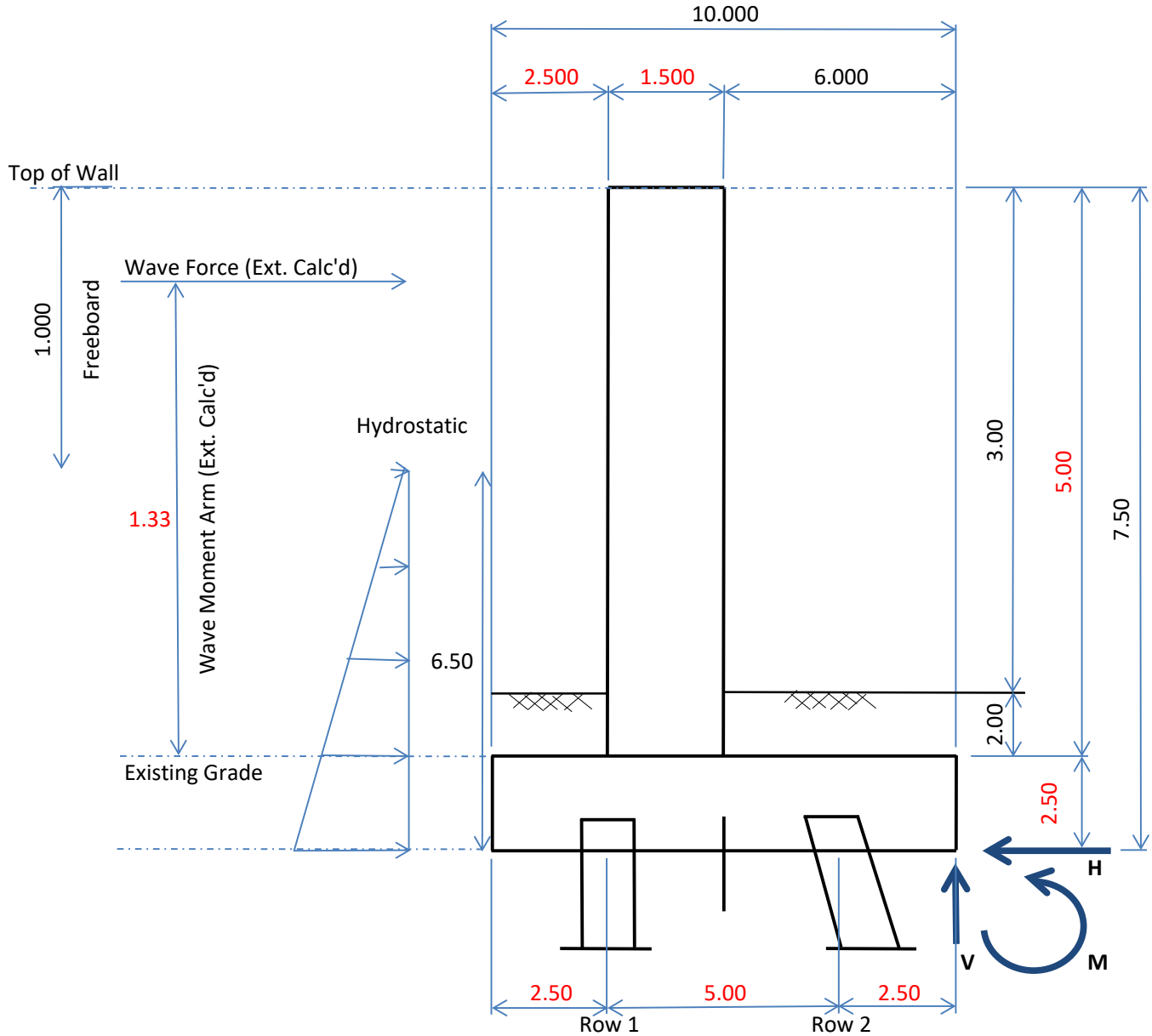
YES

3FT EXPOSED WALL HEIGHT W/ 3FT WAVE

Consider 1 ft strip wall
Not to Scale

Approximate CY Concrete per 1ft Strip Wall = 33

Approximate CY Backfill per 1ft Strip Wall = 12



PILE FORCES FOR SERVICE STAGES

Concrete Density =	0.150	Kcf
Salt Water Density =	0.064	Kcf
Soil Density =	0.125	Kcf
Wave Load on Wall - Top (p2) =	0.000	Ksf
Wave Load on Wall - Mid (p1) =	0.000	Ksf
Wave Load on Wall - Bot (p3) =	0.000	Ksf
Wave Load on Wall - Pressure =	0.261	kip/ft

	LF	L _v	V	M _v	L _H	H	M _H
LC Load Description	---	ft	Kip	Kip.ft	ft	Kip	Kip.ft
Stem Weight	1.000	6.750	1.125	7.594			
Footing Weight	1.000	5.000	3.750	18.750			
V Soil Weight - Front	1.000	8.750	0.625	5.469			
Soil Weight - Back	1.000	3.000	1.500	4.500			
Subtotal	---	---	7.000	36.313			
H Hydrostatic Pressure	1.000				2.167	1.354	2.934
H Wave Pressure	1.000				3.834	0.261	1.001
H Wave Pressure (1)	1.000				3.000	0.000	0.000
H Wave Pressure (2)	1.000				2.500	0.000	0.000
H Wave Pressure (3)	1.000				2.500	0.000	0.000
Load Comb - SERVICE IV			7.000	36.313		1.615	3.935

Resultant Forces at Neutral Axis:

V =	7.000	kips
H =	1.615	kips
M =	0.123	kips

Row 1 Pile Spacing =	10.000	ft		
Row 1 Pile Area per LF - A ₁ =	0.100	Piles	d ₁ =	2.857 ft
Row 2 Pile Spacing =	7.500	ft		
Row 2 Pile Area per LF - A ₂ =	0.133	Piles	d ₂ =	-2.143 ft
Dist. From NA to Toe -D =	4.643	ft		
Total Pile Area per LF - A =	0.233	Piles		
Moment of Inertia $\sum A_i d_i^2 - I =$	1.429	Pile*ft ²		

Row 1 Axial Pile Load - P1 =	-29.755	kips per Pile	(+ Tension)	Less Than ~30 kip/Pile?
Row 1 Axial Pile Load - P1 =	-2.975	kips per ft		YES
Row 2 Axial Pile Load - P2 =	-30.184	kips per Pile	(- Compression)	NO
Row 2 Axial Pile Load - P2 =	-4.025	kips per ft		
Shear on Pile Head =	6.922	kips per Pile		YES

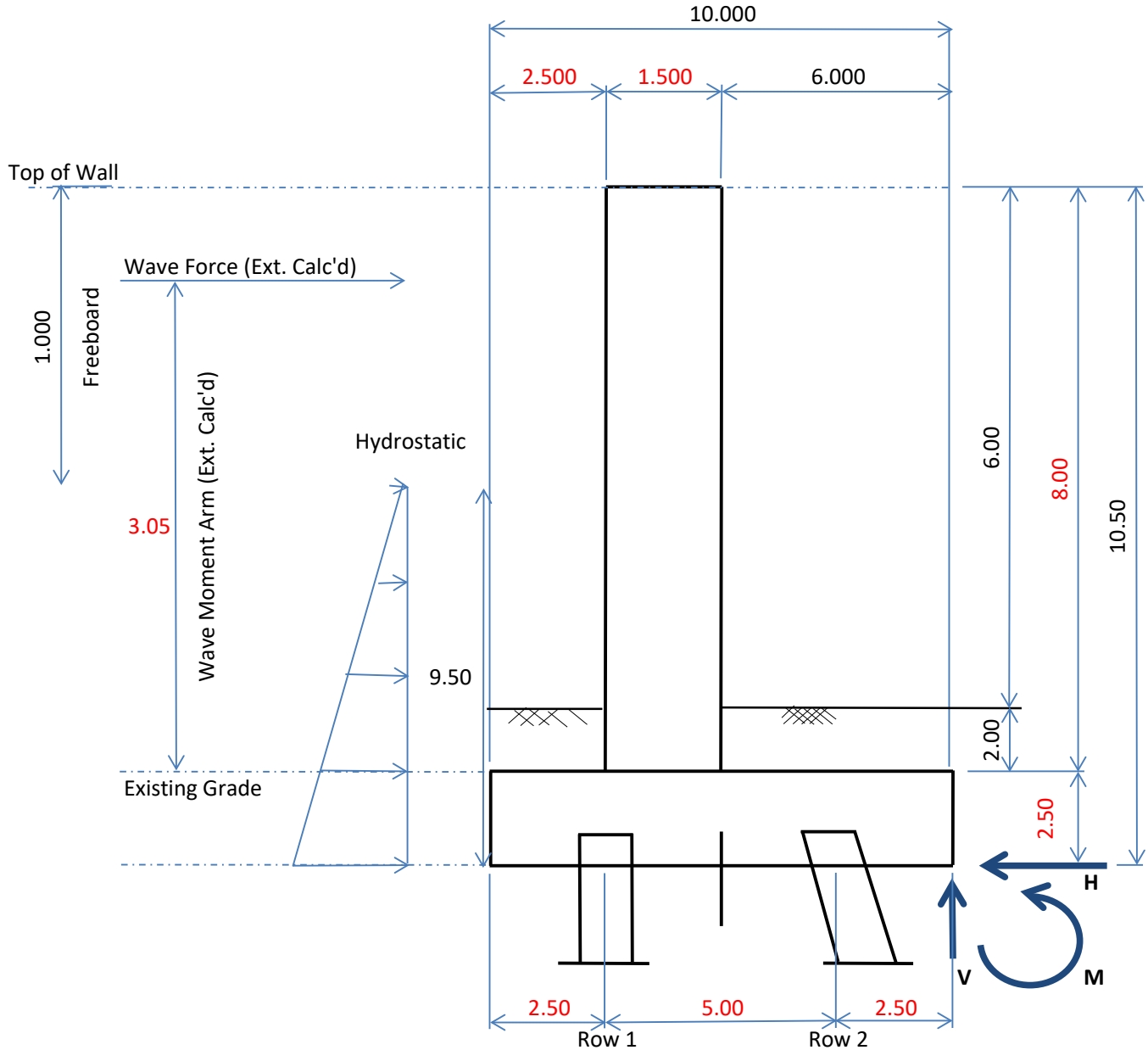
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6FT EXPOSED WALL HEIGHT W/ 3FT WAVE

Consider 1 ft strip wall
Not to Scale

Approximate CY Concrete per 1ft Strip Wall = 37

Approximate CY Backfill per 1ft Strip Wall = 12



PILE FORCES FOR SERVICE STAGES

Concrete Density =	0.150	Kcf
Salt Water Density =	0.064	Kcf
Soil Density =	0.125	Kcf
Wave Load on Wall - Top (p2) =	0.000	Ksf
Wave Load on Wall - Mid (p1) =	0.000	Ksf
Wave Load on Wall - Bot (p3) =	0.000	Ksf
Wave Load on Wall - Pressure =	1.465	kip/ft

	LF	L _v	V	M _v	L _H	H	M _H
LC Load Description	---	ft	Kip	Kip.ft	ft	Kip	Kip.ft
Stem Weight	1.000	6.750	1.800	12.150			
Footing Weight	1.000	5.000	3.750	18.750			
V Soil Weight - Front	1.000	8.750	0.625	5.469			
Soil Weight - Back	1.000	3.000	1.500	4.500			
Subtotal	---	---	7.675	40.869			
H Hydrostatic Pressure	1.000				3.167	2.893	9.160
H Wave Pressure	1.000				5.554	1.465	8.134
H Wave Pressure (1)	1.000				3.000	0.000	0.000
H Wave Pressure (2)	1.000				2.500	0.000	0.000
H Wave Pressure (3)	1.000				2.500	0.000	0.000
Load Comb - SERVICE IV			7.675	40.869		4.357	17.294

Resultant Forces at Neutral Axis:

V =	7.675	kips
H =	4.357	kips
M =	8.404	kips

Row 1 Pile Spacing =	10.000	ft
Row 1 Pile Area per LF - A ₁ =	0.100	Piles
Row 2 Pile Spacing =	5.000	ft
Row 2 Pile Area per LF - A ₂ =	0.200	Piles
Dist. From NA to Toe -D =	4.167	ft
Total Pile Area per LF - A =	0.300	Piles
Moment of Inertia $\sum A_i d_i^2 - I =$	1.667	Pile*ft ²

Row 1 Axial Pile Load - P1 =	-8.775	kips per Pile	(+ Tension)	Less Than ~30 kip/Pile?
Row 1 Axial Pile Load - P1 =	-0.878	kips per ft		YES
Row 2 Axial Pile Load - P2 =	-33.987	kips per Pile	(- Compression)	NO
Row 2 Axial Pile Load - P2 =	-6.797	kips per ft		
Shear on Pile Head =	14.524	kips per Pile		YES

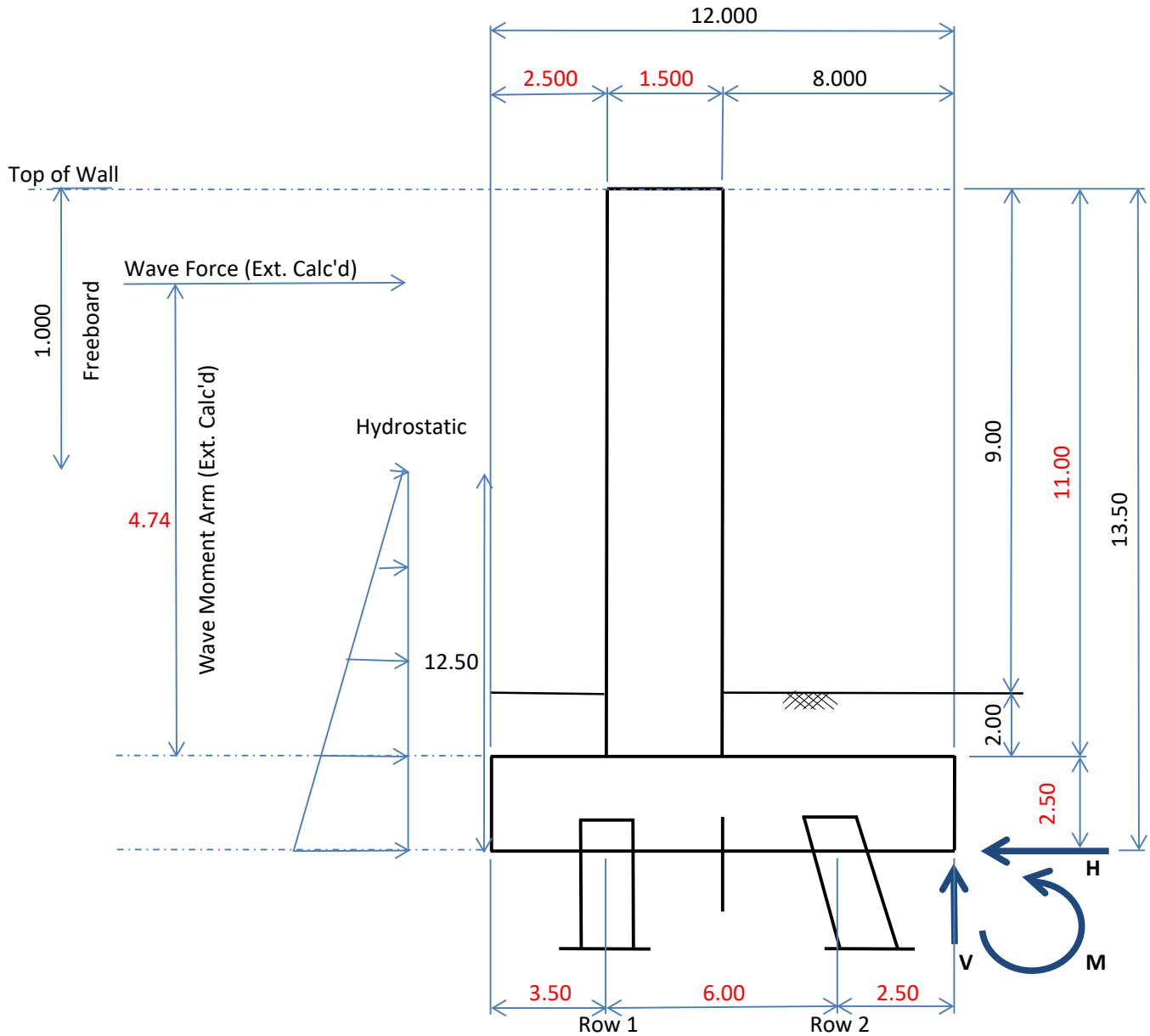
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9FT EXPOSED WALL HEIGHT W/ 3FT WAVE

Consider 1 ft strip wall
Not to Scale

Approximate CY Concrete per 1ft Strip Wall = 47

Approximate CY Backfill per 1ft Strip Wall = 16



PILE FORCES FOR SERVICE STAGES

Concrete Density =	0.150	Kcf
Salt Water Density =	0.064	Kcf
Soil Density =	0.125	Kcf
Wave Load on Wall - Top (p2) =	0.000	Ksf
Wave Load on Wall - Mid (p1) =	0.000	Ksf
Wave Load on Wall - Bot (p3) =	0.000	Ksf
Wave Load on Wall - Pressure =	2.039	kip/ft

9' Height Seemingly
inflection point for 2 versus
3 pile rows

	LF	L _v	V	M _v	L _H	H	M _H
LC Load Description	---	ft	Kip	Kip.ft	ft	Kip	Kip.ft
Stem Weight	1.000	8.750	2.475	21.656			
Footing Weight	1.000	6.000	4.500	27.000			
V Soil Weight - Front	1.000	10.750	0.625	6.719			
Soil Weight - Back	1.000	4.000	2.000	8.000			
Subtotal	---	---	9.600	63.375			
H Hydrostatic Pressure	1.000				4.167	5.008	20.866
H Wave Pressure	1.000				7.245	2.039	14.769
H Wave Pressure (1)	1.000				3.000	0.000	0.000
H Wave Pressure (2)	1.000				2.500	0.000	0.000
H Wave Pressure (3)	1.000				2.500	0.000	0.000
Load Comb - SERVICE IV			9.600	63.375		7.046	35.635

Resultant Forces at Neutral Axis:

V =	9.600	kips
H =	7.046	kips
M =	15.460	kips

Row 1 Pile Spacing =	10.000	ft
Row 1 Pile Area per LF - A ₁ =	0.100	Piles
Row 2 Pile Spacing =	5.000	ft
Row 2 Pile Area per LF - A ₂ =	0.200	Piles
Dist. From NA to Toe -D =	4.500	ft
Total Pile Area per LF - A =	0.300	Piles
Moment of Inertia $\sum A_i d_i^2$ - I =	2.400	Pile*ft ²

Row 1 Axial Pile Load - P1 =	-6.233	kips per Pile	(+ Tension)	Less Than ~30 kip/Pile?
Row 1 Axial Pile Load - P1 =	-0.623	kips per ft		YES
Row 2 Axial Pile Load - P2 =	-44.884	kips per Pile	(- Compression)	NO
Row 2 Axial Pile Load - P2 =	-8.977	kips per ft		
Shear on Pile Head =	23.488	kips per Pile		YES

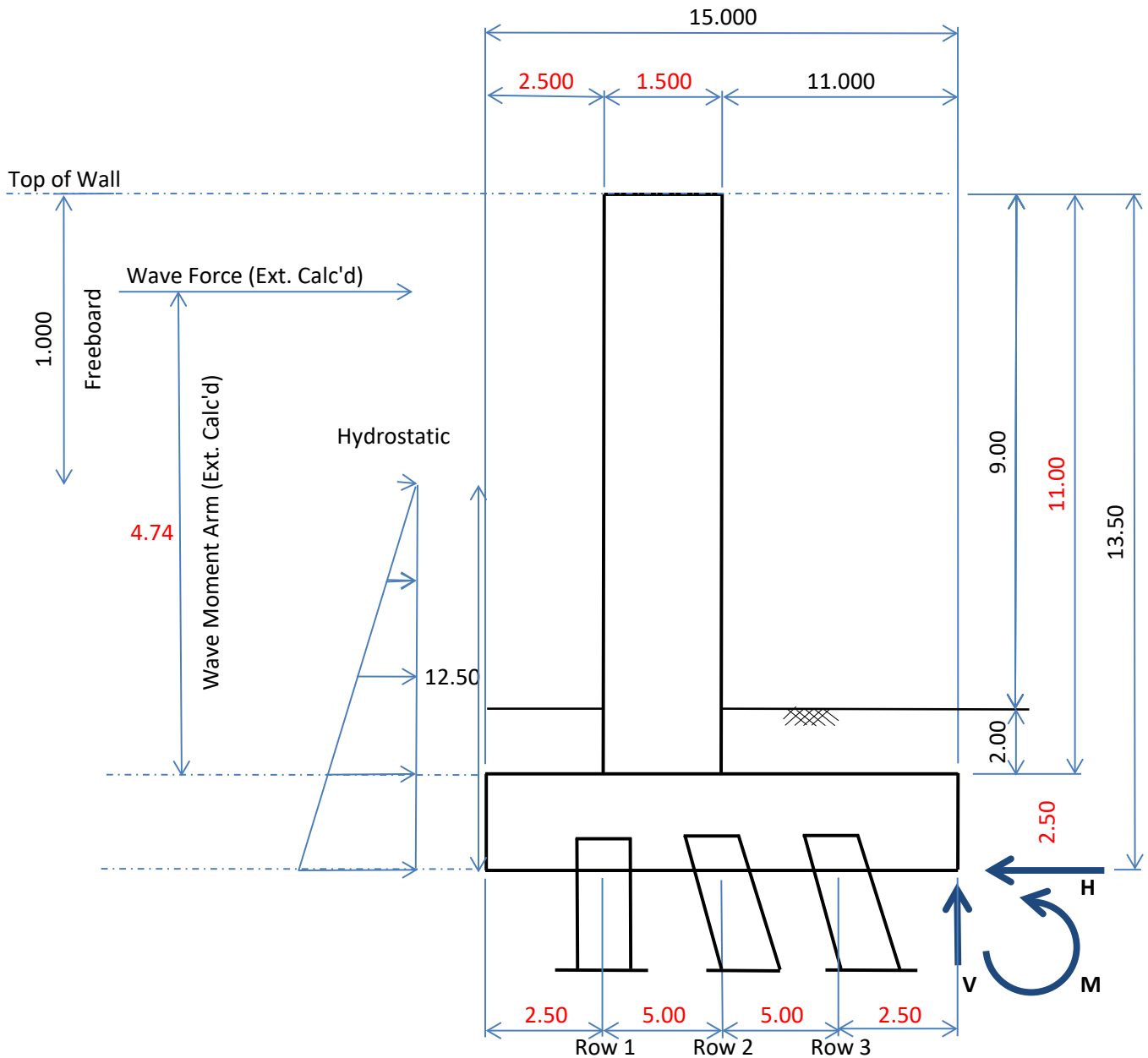
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9FT EXPOSED WALL HEIGHT W/ 3FT WAVE

Consider 1 ft strip wall
Not to Scale

Approximate CY Concrete per 1ft Strip Wall = 54

Approximate CY Backfill per 1ft Strip Wall = 22



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ine Specific Folders\Structural\T Wall Calcs Based on Wave Height\3ft Wave Height T-Wall Calcs.xlsx\9' Floodwall 3

Pile

Boston CSR
Flood Wall

Prepared by: JTD
 Checked by: MSA

Date: 9/1/2025
 Date: 6/4/2026

PILE FORCES FOR SERVICE STAGES

Concrete Density =	0.150	Kcf
Salt Water Density =	0.064	Kcf
Soil Density =	0.125	Kcf
Wave Load on Wall - Top (p2) =	0.000	Ksf
Wave Load on Wall - Mid (p1) =	0.000	Ksf
Wave Load on Wall - Bot (p3) =	0.000	Ksf
Wave Load on Wall - Pressure =	2.039	kip/ft

9' Height Seemingly
 inflection point for 2 versus
 3 pile rows

	LF	L _v	V	M _v	L _H	H	M _H
LC Load Description	---	ft	Kip	Kip.ft	ft	Kip	Kip.ft
Stem Weight	1.000	11.750	2.475	29.081			
Footing Weight	1.000	7.500	5.625	42.188			
V Soil Weight - Front	1.000	13.750	0.625	8.594			
Soil Weight - Back	1.000	5.500	2.750	15.125			
Subtotal	---	---	11.475	94.988			
H Hydrostatic Pressure	1.000				4.167	5.008	20.866
H Wave Pressure	1.000				7.245	2.039	14.769
H Wave Pressure (1)	1.000				3.000	0.000	0.000
H Wave Pressure (2)	1.000				2.500	0.000	0.000
H Wave Pressure (3)	1.000				2.500	0.000	0.000
Load Comb - SERVICE IV			11.475	94.988		7.046	35.635

Resultant Forces at Neutral Axis:

V = 11.475 kips
 H = 7.046 kips
 M = 12.367 kips

Row 1 Pile Spacing =	10.000	ft		
Row 1 Pile Area pet LF - A ₁ =	0.100	Piles	d ₁ =	6.250 ft
Row 2 Pile Spacing =	10.000	ft		
Row 2 Pile Area pet LF - A ₂ =	0.100	Piles	d ₂ =	1.250 ft
Row 3 Pile Spacing =	5.000	ft		
Row 3 Pile Area pet LF - A ₃ =	0.200	Piles	d ₂ =	-3.750 ft
Dist. From NA to Toe -D =	6.250	ft		
Total Pile Area pet LF - A =	0.400	Piles		
Moment of Inertia $\sum A_i d_i^2 - I =$	6.875	Pile*ft ²		

Less Than ~30 kip/Pile?

Row 1 Axial Pile Load - P1 =	-17.445	kips per Pile	(+ Tension)	YES
Row 1 Axial Pile Load - P1 =	-1.745	kips per ft		
Row 2 Axial Pile Load - P2 =	-26.439	kips per Pile	(- Compression)	YES
Row 2 Axial Pile Load - P2 =	-5.288	kips per ft		

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Pile

USACE, New England District

Boston CSRM
Flood Wall

Prepared by: JTD
Checked by: MSA

Date: 9/1/2025
Date: 6/4/2026

Row 3 Axial Pile Load - P3 = -35.433 kips per Pile
Row 3 Axial Pile Load - P3 = -5.669 kips per ft
Shear on Pile Head = 17.616 kips per Pile

NO

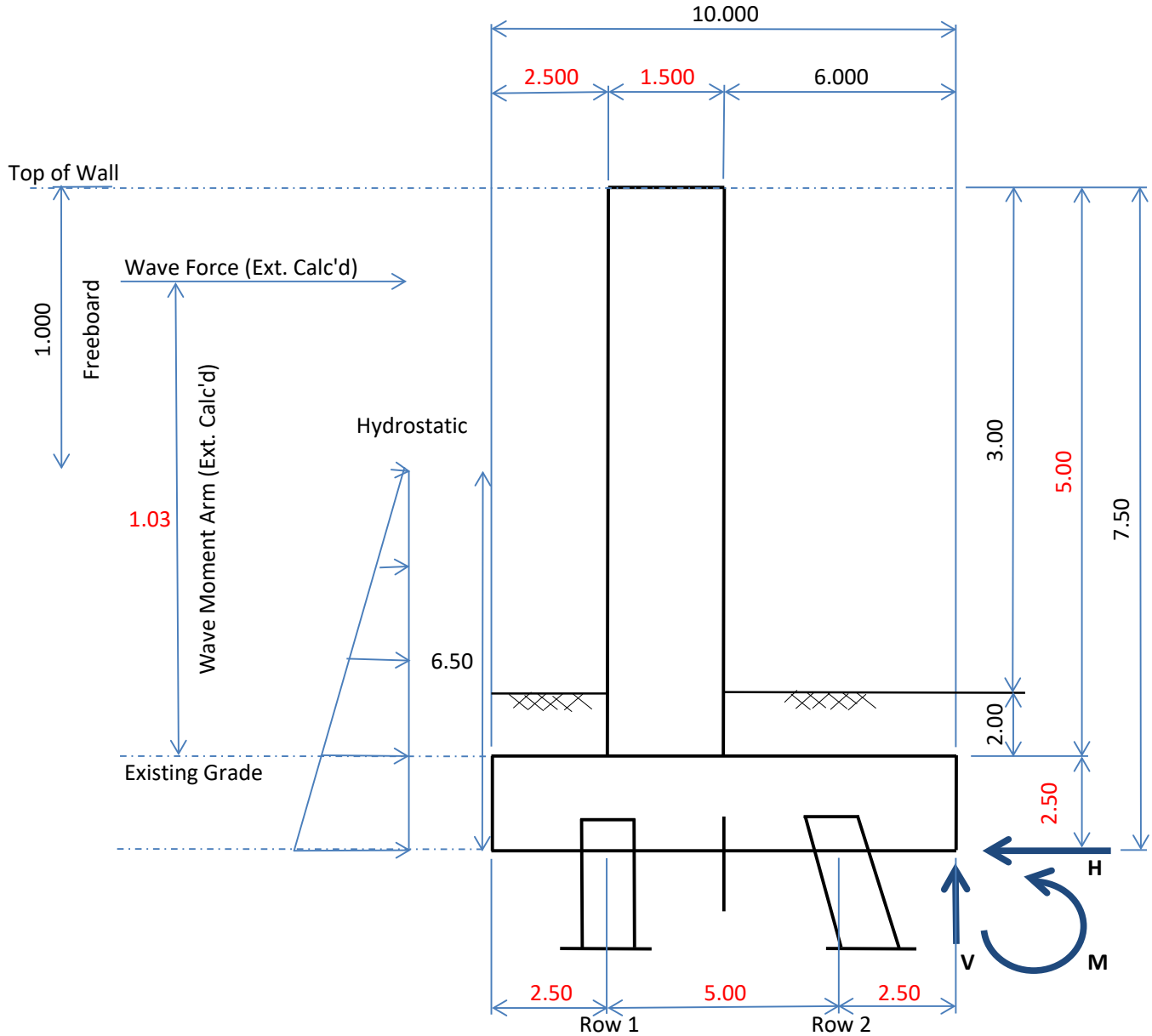
YES

3FT EXPOSED WALL HEIGHT W/ 4FT WAVE

Consider 1 ft strip wall
Not to Scale

Approximate CY Concrete per 1ft Strip Wall = 33

Approximate CY Backfill per 1ft Strip Wall = 12



PILE FORCES FOR SERVICE STAGES

Concrete Density =	0.150	Kcf
Salt Water Density =	0.064	Kcf
Soil Density =	0.125	Kcf
Wave Load on Wall - Top (p2) =	0.000	Ksf
Wave Load on Wall - Mid (p1) =	0.000	Ksf
Wave Load on Wall - Bot (p3) =	0.000	Ksf
Wave Load on Wall - Pressure =	0.064	kip/ft

	LF	L _v	V	M _v	L _H	H	M _H
LC Load Description	---	ft	Kip	Kip.ft	ft	Kip	Kip.ft
Stem Weight	1.000	6.750	1.125	7.594			
Footing Weight	1.000	5.000	3.750	18.750			
V Soil Weight - Front	1.000	8.750	0.625	5.469			
Soil Weight - Back	1.000	3.000	1.500	4.500			
Subtotal	---	---	7.000	36.313			
H Hydrostatic Pressure	1.000				2.167	1.354	2.934
H Wave Pressure	1.000				3.527	0.064	0.227
H Wave Pressure (1)	1.000				3.000	0.000	0.000
H Wave Pressure (2)	1.000				2.500	0.000	0.000
H Wave Pressure (3)	1.000				2.500	0.000	0.000
Load Comb - SERVICE IV			7.000	36.313		1.419	3.161

Resultant Forces at Neutral Axis:

V =	7.000	kips
H =	1.419	kips
M =	1.849	kips

Row 1 Pile Spacing =	7.500	ft		
Row 1 Pile Area per LF - A ₁ =	0.133	Piles	d ₁ =	2.500 ft
Row 2 Pile Spacing =	7.500	ft		
Row 2 Pile Area per LF - A ₂ =	0.133	Piles	d ₂ =	-2.500 ft
Dist. From NA to Toe -D =	5.000	ft		
Total Pile Area per LF - A =	0.267	Piles		
Moment of Inertia $\sum A_i d_i^2 - I =$	1.667	Pile*ft ²		

Row 1 Axial Pile Load - P1 =	-23.477	kips per Pile	(+ Tension)	Less Than ~30 kip/Pile?
Row 1 Axial Pile Load - P1 =	-3.130	kips per ft		YES
Row 2 Axial Pile Load - P2 =	-29.023	kips per Pile	(- Compression)	YES
Row 2 Axial Pile Load - P2 =	-3.870	kips per ft		
Shear on Pile Head =	5.320	kips per Pile		YES

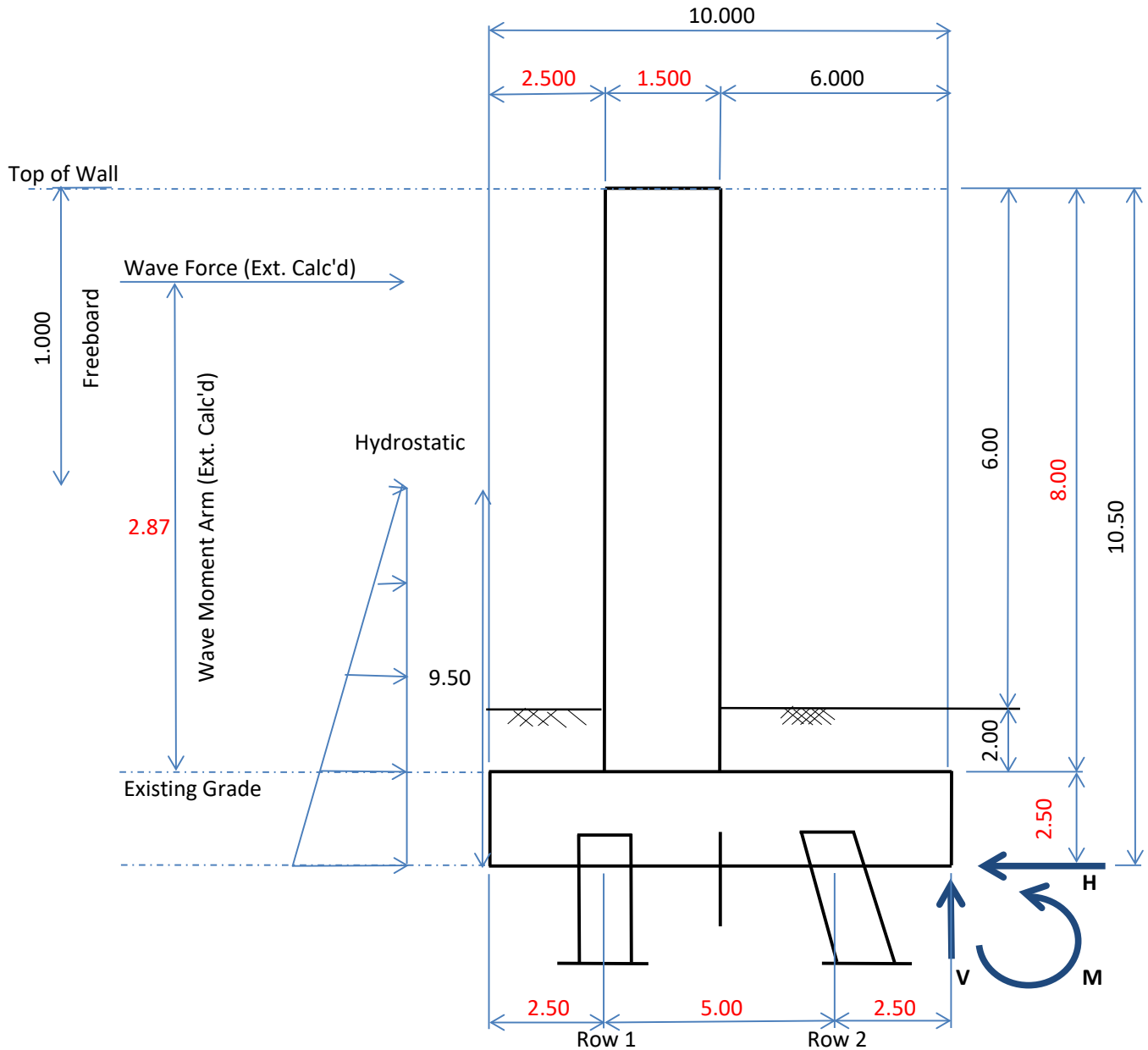
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6FT EXPOSED WALL HEIGHT W/ 4FT WAVE

Consider 1 ft strip wall
Not to Scale

Approximate CY Concrete per 1ft Strip Wall = 37

Approximate CY Backfill per 1ft Strip Wall = 12



PILE FORCES FOR SERVICE STAGES

Concrete Density =	0.150	Kcf
Salt Water Density =	0.064	Kcf
Soil Density =	0.125	Kcf
Wave Load on Wall - Top (p2) =	0.000	Ksf
Wave Load on Wall - Mid (p1) =	0.000	Ksf
Wave Load on Wall - Bot (p3) =	0.000	Ksf
Wave Load on Wall - Pressure =	1.145	kip/ft

	LF	L _v	V	M _v	L _H	H	M _H
LC Load Description	---	ft	Kip	Kip.ft	ft	Kip	Kip.ft
Stem Weight	1.000	6.750	1.800	12.150			
Footing Weight	1.000	5.000	3.750	18.750			
V Soil Weight - Front	1.000	8.750	0.625	5.469			
Soil Weight - Back	1.000	3.000	1.500	4.500			
Subtotal	---	---	7.675	40.869			
H Hydrostatic Pressure	1.000				3.167	2.893	9.160
H Wave Pressure	1.000				5.367	1.145	6.146
H Wave Pressure (1)	1.000				3.000	0.000	0.000
H Wave Pressure (2)	1.000				2.500	0.000	0.000
H Wave Pressure (3)	1.000				2.500	0.000	0.000
Load Comb - SERVICE IV			7.675	40.869		4.038	15.305

Resultant Forces at Neutral Axis:

V =	7.675	kips
H =	4.038	kips
M =	6.416	kips

Row 1 Pile Spacing =	10.000	ft		
Row 1 Pile Area per LF - A ₁ =	0.100	Piles	d ₁ =	3.333 ft
Row 2 Pile Spacing =	5.000	ft		
Row 2 Pile Area per LF - A ₂ =	0.200	Piles	d ₂ =	-1.667 ft
Dist. From NA to Toe -D =	4.167	ft		
Total Pile Area per LF - A =	0.300	Piles		
Moment of Inertia $\sum A_i d_i^2 - I =$	1.667	Pile*ft ²		

Row 1 Axial Pile Load - P1 =	-12.752	kips per Pile	(+ Tension)	Less Than ~30 kip/Pile?
Row 1 Axial Pile Load - P1 =	-1.275	kips per ft		YES
Row 2 Axial Pile Load - P2 =	-31.999	kips per Pile	(- Compression)	NO
Row 2 Axial Pile Load - P2 =	-6.400	kips per ft		
Shear on Pile Head =	13.459	kips per Pile		YES

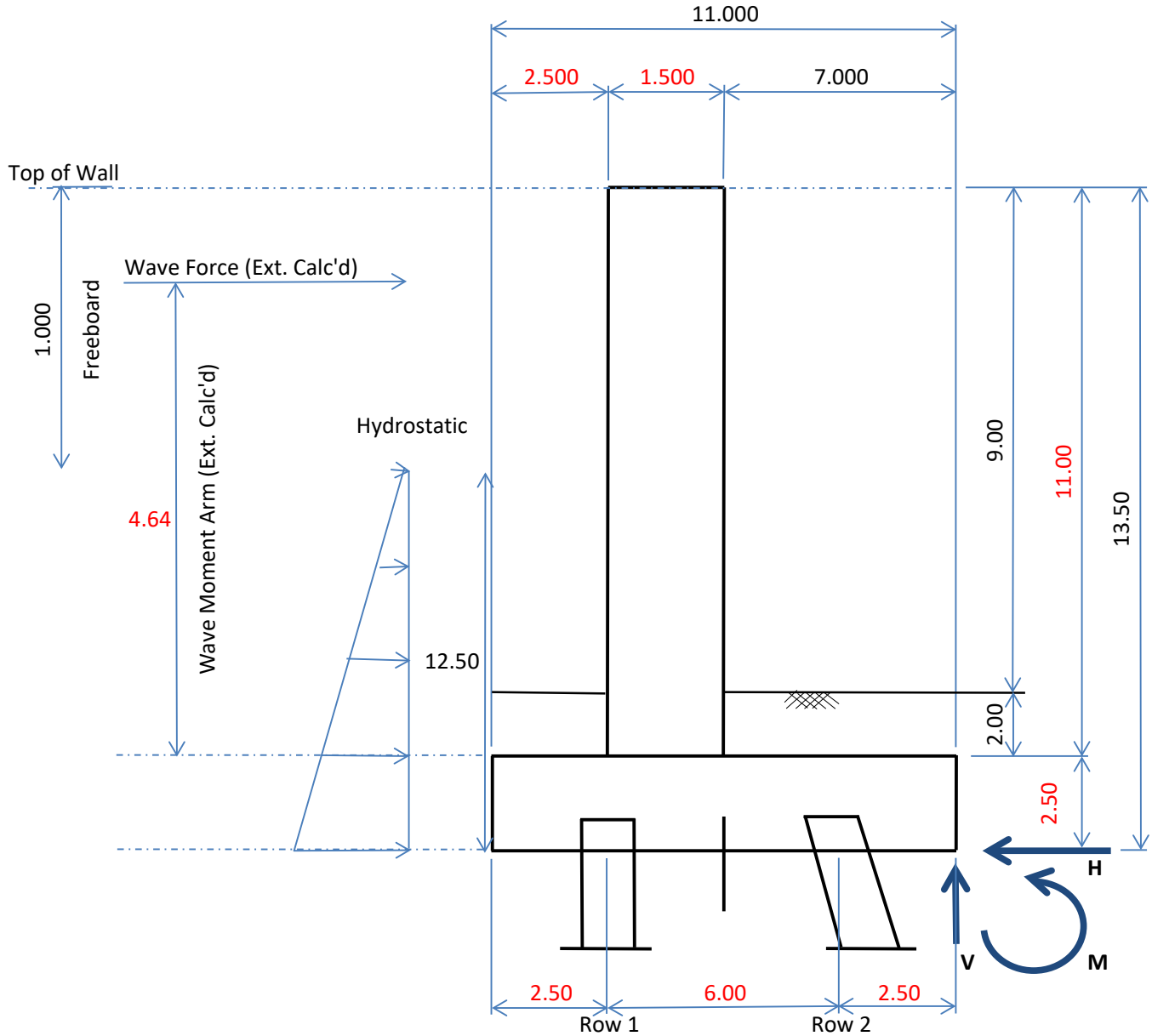
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9FT EXPOSED WALL HEIGHT W/ 4FT WAVE

Consider 1 ft strip wall
Not to Scale

Approximate CY Concrete per 1ft Strip Wall = 44

Approximate CY Backfill per 1ft Strip Wall = 14



PILE FORCES FOR SERVICE STAGES

Concrete Density =	0.150	Kcf
Salt Water Density =	0.064	Kcf
Soil Density =	0.125	Kcf
Wave Load on Wall - Top (p2) =	0.000	Ksf
Wave Load on Wall - Mid (p1) =	0.000	Ksf
Wave Load on Wall - Bot (p3) =	0.000	Ksf
Wave Load on Wall - Pressure =	2.801	kip/ft

9' Height Seemingly
inflection point for 2 versus
3 pile rows

	LF	L _v	V	M _v	L _H	H	M _H
LC Load Description	---	ft	Kip	Kip.ft	ft	Kip	Kip.ft
Stem Weight	1.000	7.750	2.475	19.181			
Footing Weight	1.000	5.500	4.125	22.688			
V Soil Weight - Front	1.000	9.750	0.625	6.094			
Soil Weight - Back	1.000	3.500	1.750	6.125			
Subtotal	---	---	8.975	54.088			
H Hydrostatic Pressure	1.000				4.167	5.008	20.866
H Wave Pressure	1.000				7.137	2.801	19.992
H Wave Pressure (1)	1.000				3.000	0.000	0.000
H Wave Pressure (2)	1.000				2.500	0.000	0.000
H Wave Pressure (3)	1.000				2.500	0.000	0.000
Load Comb - SERVICE IV			8.975	54.088		7.809	40.858

Resultant Forces at Neutral Axis:

V =	8.975	kips
H =	7.809	kips
M =	27.158	kips

Row 1 Pile Spacing =	10.000	ft
Row 1 Pile Area per LF - A ₁ =	0.100	Piles
Row 2 Pile Spacing =	5.000	ft
Row 2 Pile Area per LF - A ₂ =	0.200	Piles
Dist. From NA to Toe -D =	4.500	ft
Total Pile Area per LF - A =	0.300	Piles
Moment of Inertia $\sum A_i d_i^2$ - I =	2.400	Pile*ft ²

Row 1 Axial Pile Load - P1 =	15.346	kips per Pile	(+ Tension)
Row 1 Axial Pile Load - P1 =	1.535	kips per ft	
Row 2 Axial Pile Load - P2 =	-52.548	kips per Pile	(- Compression)
Row 2 Axial Pile Load - P2 =	-10.510	kips per ft	
Shear on Pile Head =	26.030	kips per Pile	

Less Than ~30 kip/Pile?

YES

NO

YES

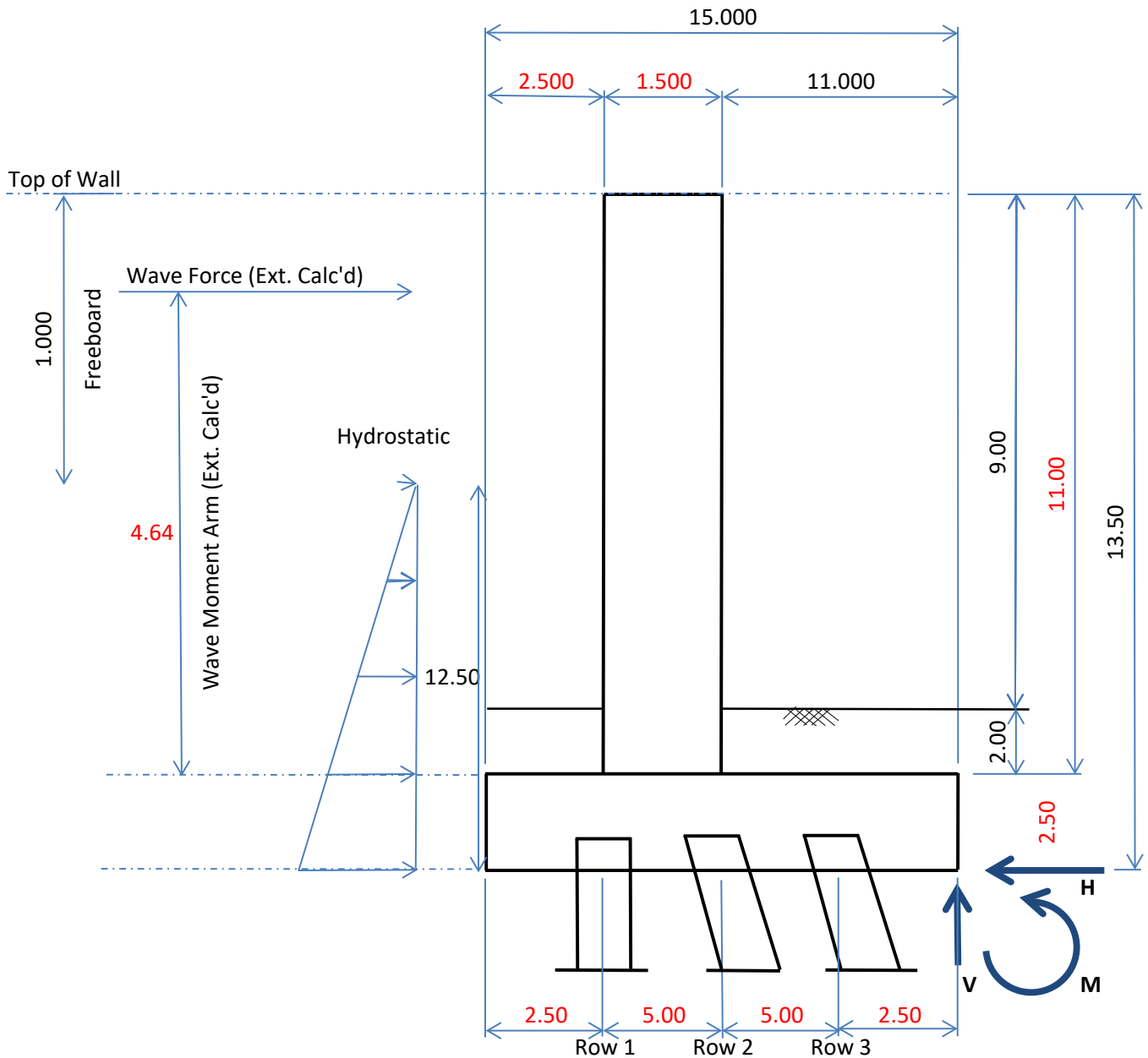
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9FT EXPOSED WALL HEIGHT W/ 4FT WAVE

Consider 1 ft strip wall
Not to Scale

Approximate CY Concrete per 1ft Strip Wall = 54

Approximate CY Backfill per 1ft Strip Wall = 22



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Boston CSRM
Flood Wall

Prepared by: JTD
Checked by: MSA

Date: 9/1/2025
Date: 6/4/2026

PILE FORCES FOR SERVICE STAGES

Concrete Density =	0.150	Kcf
Salt Water Density =	0.064	Kcf
Soil Density =	0.125	Kcf
Wave Load on Wall - Top (p2) =	0.000	Ksf
Wave Load on Wall - Mid (p1) =	0.000	Ksf
Wave Load on Wall - Bot (p3) =	0.000	Ksf
Wave Load on Wall - Pressure =	2.801	kip/ft

9' Height Seemingly
inflection point for 2 versus
3 pile rows

	LF	L _v	V	M _v	L _H	H	M _H
LC Load Description	---	ft	Kip	Kip.ft	ft	Kip	Kip.ft
Stem Weight	1.000	11.750	2.475	29.081			
Footing Weight	1.000	7.500	5.625	42.188			
V Soil Weight - Front	1.000	13.750	0.625	8.594			
Soil Weight - Back	1.000	5.500	2.750	15.125			
Subtotal	---	---	11.475	94.988			
H Hydrostatic Pressure	1.000				4.167	5.008	20.866
H Wave Pressure	1.000				7.137	2.801	19.992
H Wave Pressure (1)	1.000				3.000	0.000	0.000
H Wave Pressure (2)	1.000				2.500	0.000	0.000
H Wave Pressure (3)	1.000				2.500	0.000	0.000
Load Comb - SERVICE IV			11.475	94.988		7.809	40.858

Resultant Forces at Neutral Axis:

V = 11.475 kips
H = 7.809 kips
M = 17.589 kips

Row 1 Pile Spacing =	10.000	ft		
Row 1 Pile Area pet LF - A ₁ =	0.100	Piles	d ₁ =	6.250 ft
Row 2 Pile Spacing =	10.000	ft		
Row 2 Pile Area pet LF - A ₂ =	0.100	Piles	d ₂ =	1.250 ft
Row 3 Pile Spacing =	5.000	ft		
Row 3 Pile Area pet LF - A ₃ =	0.200	Piles	d ₂ =	-3.750 ft
Dist. From NA to Toe -D =	6.250	ft		
Total Pile Area pet LF - A =	0.400	Piles		
Moment of Inertia $\sum A_i d_i^2 - I =$	6.875	Pile*ft ²		

Less Than ~30 kip/Pile?

Row 1 Axial Pile Load - P1 = -12.698 kips per Pile (+ Tension)

YES

Row 1 Axial Pile Load - P1 = -1.270 kips per ft

Row 2 Axial Pile Load - P2 = -25.490 kips per Pile (- Compression)

YES

Row 2 Axial Pile Load - P2 = -5.098 kips per ft

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Pile

USACE, New England District

Boston CSRM
Flood Wall

Prepared by: JTD
Checked by: MSA

Date: 9/1/2025
Date: 6/4/2026

Row 3 Axial Pile Load - P3 = -38.281 kips per Pile
Row 3 Axial Pile Load - P3 = -6.125 kips per ft
Shear on Pile Head = 19.523 kips per Pile

NO

YES