HNTB	Made by	Date	Job No.
	BBB/JTW	09/06/11	46933
	Checked by	Date	
	RSB	12/27/11	Sheet No.
Calculations For	Backchecked by	Date	
BL16&17			

File: c:\caddlib\pw\jwroten\db\dms72727\(Abut_Design_Monument-REAR-RFI Thin Wall.xls]INPU 12/23/2011 8:57

NOTE:
- SPREADSHEET CREATED BY RSB FOR ORIGINAL DESIGN. JTW HAS REVISED THE CALCULATIONS TO ACCOUNT FOR REVISIONS MADE TO THE MONUMENT BY THE MANUFACTURER. RSB THEN CHECKED THE REVISIONS. (TYPICAL FOR BOTH MONUMENTS)

MONUMENT (REAR)

INPUT DATA

GENERAL

γ_{CONC} = 0.15 K/FT³
γ_{SOIL} = 0.12 K/FT³

FOOTING

H_{TOE} =	3.75	FT	H_{HEEL} =	3.75	FT
COVER =	3.5	IN	COVER =	3.5	IN
d_{TOE} =	41.5	IN	d_{HEEL} =	41.5	IN

L = 10.83 FT
W_{TOE} = 0.33 FT
W = 5.33 FT

KNEE

H = 0 FT
L = 0.00 FT
W = 0.00 FT

STEM

H = T/MON - B/FTG - H_{FTG} - H_{KNEE}
T/MON = 703.27
B/FTG = 663.30
H_{FTG} = 3.75 FT
H_{KNEE} = 0.00 FT
H = 36.22 FT (REAR ABUTMENT MONUMENT CONTROLS)

L = 10.33 FT (MAX LENGTH)
T = 5.00 FT

HORIZONTAL LOADS
WIND PRESSURE ON STRUCTURE
H1. WIND PRESSURE

H1 = PD * A
A = WxL
W = 10.3 FT
H = T/MON - T/GROUND
T/MON = 703.3
T/GROUND = 669.0
H = 34.3 FT
A = 354.1 FT²

PD = PB*(VDZ²/10000)
PB = 0.05 K/FT²
VDZ = 2.5*V0*(V30/VB)*LN(Z/Z0)
V0 = 10.9 MPH
V30 = 110 MPH (ESTIMATE)
VB = 100 MPH
Z = 34.3 FT
Z0 = 3.28 FT
VDZ = 70.33 MPH
PD = 0.025 K/FT²

H1 = 8.76 K
H1 = 0.85 K/FT

X1 = (T/MON - B/FTG) + H/2
(X = ARM BASED ON MOMENT ABOUT TOE OF FTG, TYP.)
X1 = 22.8 FT

VERTICAL LOADS
DEAD LOADS
V1. STEM

V2 = (H * (A1-A2)/L) * γ
A1 = 49.9 FT² (TOTAL AREA)
A2 = 28 FT² (VOID AREA)

REVISED PER MANUFACTURERS CHANGE TO THE MONUMENT WALL THICKNESS

V2 = 11.51 K/FT
X2 = 2.8 FT

V2. FOOTING

V2 = H * T * γ
V2 = 3.00 K/FT
X2 = 2.7 FT

V3. KNEE

V3 = H * T * γ
V3 = 0.00 K/FT
X3 = 4.2 FT

For	BL16&17	Job No.	46939	Sheet No.	
Made by	RSB/JTW	Checked by	RSB	Backchecked by	
Date	9/6/2011	Date	12/21/11	Date	

HNTB

MONUMENT (REAR)
DETERMINE PILE LOADS FOR ABUTMENT

File: c:\cadd\lib\pw\jwroten\db\dms72727\[Abut_Design_Monument-REAR-RFI Thin Wall.xls]PILES - CASE 1

LOAD MODIFIER
η = 1.00

LOAD FACTORS
γDC = 1.25
γWS = 1.40

RESISTANCE FACTOR
Φ_{DYN} = 0.7
Φ_{UPLIFT} = 0.35

"BEARING" OR "FRICTION" PILE: FRICTION
LOAD CASE 1-2: 1

STRENGTH III

MONUMENT CONSTRUCTED.
WIND LOAD, PERPENDICULAR TO FRONT FACE OF MONUMENT.
(CRITICAL: BACK ROW PILE CAPACITY)
MAX HORIZONTAL LOAD FACTORS AND MAX VERTICAL LOAD FACTORS.

VERTICAL FORCES

		UNFACTORED (SERVICE LOAD)			FACTORED		
Factor	**Description**	**ΣQ_V**	**(X)**	**ΣM_R**	**$\Sigma(\eta\gamma Q_V)$**	**(X)**	**$\Sigma(\eta\gamma M_R)$**
DC	V1. STEM	11.51 k/ft	2.83 ft	32.62 k-ft/ft	14.39 k/ft	2.83 ft	40.78 k-ft/ft
	V2. FOOTING	3.00 k/ft	2.67 ft	7.99 k-ft/ft	3.75 k/ft	2.67 ft	9.99 k-ft/ft
	V3. KNEE	0.00 k/ft	4.17 ft	0.00 k-ft/ft	0.00 k/ft	4.17 ft	0.00 k-ft/ft
	TOTAL =	**14.5 k-ft**		**40.6 k-ft/ft**	**18.1 k-ft**		**50.8 k-ft/ft**

HORIZONTAL FORCES

		UNFACTORED (SERVICE LOAD)			FACTORED		
Factor	**Description**	**ΣQ_H**	**(X)**	**ΣM_D**	**$\Sigma(\eta\gamma Q_H)$**	**(X)**	**$\Sigma(\eta\gamma M_D)$**
WS	H1. WIND PRESSURE	0.85 k/ft	22.84 ft	19.36 k-ft	1.19 k/ft	22.84 ft	27.10 k-ft
	TOTAL =	**0.8 k-ft**		**19.4 k-ft/ft**	**1.2 k-ft**		**27.1 k-ft/ft**

$\Sigma M_{toe} = \Sigma M_R + \Sigma M_D$ = **60.0 k-ft/ft**
Resultant = $\Sigma M/\Sigma Q_V$ = **4.13 ft (from toe)**

$\Sigma M_{toe} = \Sigma(\eta\gamma M_R) + \Sigma(\eta\gamma M_D)$ = **77.9 k-ft/ft**
Resultant = $\Sigma M/\Sigma(\eta\gamma QV)$ = **4.29 ft (from toe)**

PILE REACTIONS

Pile type = 8
Rr = 165 k
Rr (uplift) = -83 k

Pile size and design loads per OBDM 2007 and Geotech Report

Number of piles in front row (odd) = 2
Number of piles in second row (odd) = 0
Number of piles in back row = 2
Front row pile spacing = 5.22 ft
Length of pile analysis strip = 10.83 ft
Distance to front row of piles = 1.50 ft
Distance to second row of piles = 0.00 ft
Distance to back row of piles = 3.83 ft
Centroid of piles from toe = 2.67 ft

Σd^2 and Section Moduli

	Distance to pile centroid	d^2	Section Modulus
Front row	1.17 ft	2.72 pile-ft^2	4.67 pile-ft
2nd row	0.00 ft	0.00 pile-ft^2	0.00 pile-ft
Back row	-1.17 ft	2.72 pile-ft^2	-4.67 pile-ft
	Σd^2 =	5.44 pile-ft^2	

BEARING PILES			
Type	Pile	R_R	Pile diameter
1	HP10x42	310 k	10.08 in
2	HP12x53	380 k	12.05 in
3	HP14x73	530 k	14.59 in
FRICTION PILES			
Type	Pile	R_n	Pile diameter
4	HP10x42	350 k	10.08 in
5	HP12x53	380 k	12.05 in
6	HP14x73	440 k	14.59 in
7	12" C.I.P.	330 k	12 in
8	14" C.I.P.	236 k	(Innerbelt)*
9	16" C.I.P.	450 k	16 in
10	HP16x88	540 k	(Innerbelt)

* Rn calculated using Shannon & Wilson "Estimated Axial Pile Resistance Chart".

Unfactored Condition (Service Load)

Eccentricity = e = -1.47 ft

Loads and moment per strip:
Vertical load = ΣV = 157.2 k-ft
ΣM about centroid of piles = ΣV*e = -230.4 k-ft

Vertical pile reactions:
Front row = -10.1 k/pile
Second row = 0.0 k/pile
Back row = 88.7 k/pile

Horiz. pile reactions:
Front row batter = 99999.0
Second row batter = 99999.0
Horiz. component of front row = 0.0 k/pile
Horiz. component of second row = 0.0 k/pile
Total Horiz. component = 0.0 k/pile

Final Pile Reactions (ΣQ):
Front row (axial) = -10.1 k/pile
Second row (axial) = 0.0 k/pile
Back row = 88.7 k/pile

Factored Condition

Eccentricity = e = -1.63 ft

Loads and moment per strip:
Vertical load = ΣV = 196.5 k-ft
ΣM about centroid of piles = ΣV*e = -319.5 k-ft

Vertical pile reactions:
Front row = -19.3 k/pile
Second row = 0.0 k/pile
Back row = 117.6 k/pile

Horiz. pile reactions:
Front row batter = 99999.0
Second row batter = 99999.0
Horiz. component of front row = 0.0 k/pile
Horiz. component of second row = 0.0 k/pile
Total Horiz. component = 0.0 k/pile

Final Pile Reactions ($\Sigma\eta\gamma Q$):
Front row (axial) = -19.3 k/pile **OK**
Second row (axial) = 0.0 k/pile **OK**
Back row = 117.6 k/pile **OK**

Final Pile Reactions, ($\Sigma\eta\gamma Q/\Phi$): (ULTIMATE BEARING VALUE, Rn)
Front row (axial) = 13.8 Ton/pile
Second row (axial) = 0.0 Ton/pile
Back row = 84.0 Ton/pile

Overturn/Uplift:
OK

For	BL16&17	Job No.	46933	Sheet No.	
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Date	9/6/2011	Date	9/7/11	Date	

HNTB

MONUMENT (REAR)
DETERMINE PILE LOADS FOR ABUTMENT

File: c:\caddlib\pw\jwroten\db\dms72727\[Abut_Design_Monument-REAR-RFI Thin Wall.xls]PILES - CASE 2

LOAD MODIFIER
η = 1.00

LOAD FACTORS
γDC = 0.90
γWS = 1.40

RESISTANCE FACTOR
Φ_{DYN} = 0.7
Φ_{UPLIFT} = 0.35

"BEARING" OR "FRICTION" PILE: FRICTION
LOAD CASE 1-2: 2
STRENGTH III
MONUMENT CONSTRUCTED.
WIND LOAD, PERPENDICULAR TO FRONT FACE OF MONUMENT.
(CRITICAL: FRONT ROW PILE UPLIFT)
MAX HORIZONTAL LOAD FACTORS AND MIN VERTICAL LOAD FACTORS.

VERTICAL FORCES

		UNFACTORED (SERVICE LOAD)			FACTORED		
Factor	Description	ΣQ_V	(X)	ΣM_R	$\Sigma(\eta\gamma Q_V)$	(X)	$\Sigma(\eta\gamma M_R)$
DC	V1. STEM	11.51 k/ft	2.83 ft	32.62 k-ft/ft	10.36 k/ft	2.83 ft	29.36 k-ft/ft
	V2. FOOTING	3.00 k/ft	2.67 ft	7.99 k-ft/ft	2.70 k/ft	2.67 ft	7.19 k-ft/ft
	V3. KNEE	0.00 k/ft	4.17 ft	0.00 k-ft/ft	0.00 k/ft	4.17 ft	0.00 k-ft/ft
	TOTAL =	**14.5 k-ft**		**40.6 k-ft/ft**	**13.1 k-ft**		**36.6 k-ft/ft**

HORIZONTAL FORCES

		UNFACTORED (SERVICE LOAD)			FACTORED		
Factor	Description	ΣQ_H	(X)	ΣM_D	$\Sigma(\eta\gamma Q_H)$	(X)	$\Sigma(\eta\gamma M_D)$
WS	H1. WIND PRESSURE	0.85 k/ft	22.84 ft	19.36 k-ft	1.19 k/ft	22.84 ft	27.10 k-ft
	TOTAL =	**0.8 k-ft**		**19.4 k-ft/ft**	**1.2 k-ft**		**27.1 k-ft/ft**

$\Sigma M_{toe} = \Sigma M_R + \Sigma M_D$ = **60.0 k-ft/ft**
Resultant = $\Sigma M/\Sigma Q_V$ = **4.13 ft (from toe)**

$\Sigma M_{toe} = \Sigma(\eta\gamma M_R) + \Sigma(\eta\gamma M_D)$ = **63.7 k-ft/ft**
Resultant = $\Sigma M/\Sigma(\eta\gamma QV)$ = **4.87 ft (from toe)**

PILE REACTIONS

Pile type = 8
Rr = 165 k
Rr (uplift) = -83 k

Pile size and design loads per OBDM 2007 and Geotech Report

Number of piles in front row (odd) = 2
Number of piles in second row (odd) = 0
Number of piles in back row = 2
Front row pile spacing = 5.22 ft
Length of pile analysis strip = 10.83 ft
Distance to front row of piles = 1.50 ft
Distance to second row of piles = 0.00 ft
Distance to back row of piles = 3.83 ft
Centroid of piles from toe = 2.67 ft

Σd^2 and Section Moduli

	Distance to pile centroid	d^2	Section Modulus
Front row	1.17 ft	2.72 pile-ft^2	4.67 pile-ft
2nd row	0.00 ft	0.00 pile-ft^2	0.00 pile-ft
Back row	-1.17 ft	2.72 pile-ft^2	-4.67 pile-ft
	Σd^2 =	5.44 pile-ft^2	

BEARING PILES			
Type	Pile	R_R	Pile diameter
1	HP10x42	310 k	10.08 in
2	HP12x53	380 k	12.05 in
3	HP14x73	530 k	14.59 in
FRICTION PILES			
Type	Pile	R_n	Pile diameter
4	HP10x42	350 k	10.08 in
5	HP12x53	380 k	12.05 in
6	HP14x73	440 k	14.59 in
7	12" C.I.P.	330 k	12 in
8	14" C.I.P.	236 k	(Innerbelt)*
9	16" C.I.P.	450 k	16 in
10	HP16x88	540 k	(INNERBELT)

* Rn calculated using Shannon & Wilson "Estimated Axial Pile Resistance Chart".

Unfactored Condition (Service Load)

Eccentricity = e = -1.47 ft

Loads and moment per strip:
Vertical load = ΣV = 157.2 k-ft
ΣM about centroid of piles = ΣV^*e = -230.4 k-ft

Vertical pile reactions:
Front row = -10.1 k/pile
Second row = 0.0 k/pile
Back row = 88.7 k/pile

Horiz. pile reactions:
Front row batter = 99999.0
Second row batter = 99999.0
Horiz. component of front row = 0.0 k/pile
Horiz. component of second row = 0.0 k/pile
Total Horiz. component = 0.0 k/pile

Final Pile Reactions (ΣQ):
Front row (axial) = -10.1 k/pile
Second row (axial) = 0.0 k/pile
Back row = 88.7 k/pile

Factored Condition

Eccentricity = e = -2.21 ft

Loads and moment per strip:
Vertical load = ΣV = 141.5 k-ft
ΣM about centroid of piles = ΣV^*e = -312.2 k-ft

Vertical pile reactions:
Front row = -31.5 k/pile
Second row = 0.0 k/pile
Back row = 102.3 k/pile

Horiz. pile reactions:
Front row batter = 99999.0
Second row batter = 99999.0
Horiz. component of front row = 0.0 k/pile
Horiz. component of second row = 0.0 k/pile
Total Horiz. component = 0.0 k/pile

Final Pile Reactions ($\Sigma\eta\gamma Q$):
Front row (axial) = -31.5 k/pile **OK**
Second row (axial) = 0.0 k/pile **OK**
Back row = 102.3 k/pile **OK**

Final Pile Reactions, ($\Sigma\eta\gamma Q/\Phi$): (ULTIMATE BEARING VALUES, Rn)
Front row (axial) = 22.5 Ton/pile ← MAX UPLIFT
Second row (axial) = 0.0 Ton/pile OK
Back row = 73.1 Ton/pile

Overturn/Uplift:
OK

HNTB	Made by	Date	Job No.
	RBB/JTW	09/06/11	46933
	Checked by	Date	
	KSB	12/27/11	Sheet No.
Calculations For	Backchecked by	Date	
BL16&17			

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SEE REAR MONUMENT CALCS FOR EXPLANATION OF REVISION

MONUMENT (FORWARD)

INPUT DATA

GENERAL

γ_{CONC} = 0.15 K/FT³

γ_{SOIL} = 0.12 K/FT³

FOOTING

H_{TOE} = 3.75 FT
COVER = 3.5 IN
d_{TOE} = 41.5 IN

H_{HEEL} = 3.75 FT
COVER = 3.5 IN
d_{HEEL} = 41.5 IN

L = 10.83 FT
W_{TOE} = 0.33 FT
W = 6.30 FT

KNEE

H = 0 FT
L = 0.00 FT
W = 0.00 FT (AVERAGE)

STEM

H = T/MON - B/FTG - H_{FTG} - H_{KNEE}
T/MON = 702.00
B/FTG = 662.70
H_{FTG} = 3.75 FT
H_{KNEE} = 0.00 FT
H = 35.55 FT (REAR ABUTMENT MONUMENT CONTROLS)

L = 10.33 FT (MAX LENGTH)
T = 5.00 FT

HORIZONTAL LOADS

WIND PRESSURE ON STRUCTURE

H1. WIND PRESSURE

H1 = PD * A

A = WxL

W = 10.3 FT

H = T/MON - T/GROUND

T/MON = 702.0

T/GROUND = 668.0

H = 34.0 FT

A = 351.3 FT²

PD = PB*(VDZ²/10000)

PB = 0.05 K/FT²

VDZ = 2.5*V0*(V30/VB)*LN(Z/Z0)

V0 = 10.9 MPH

V30 = 110 MPH (ESTIMATE)

VB = 100 MPH

Z = 34.0 FT

Z0 = 3.28 FT

VDZ = 70.10 MPH

PD = 0.025 K/FT²

H1 = 8.63 K

H1 = 0.84 K/FT

X1 = (T/MON - B/FTG) + H/2

(X = ARM BASED ON MOMENT ABOUT TOE OF FTG, TYP.)

X1 = 22.3 FT

VERTICAL LOADS

DEAD LOADS

V1. STEM

V2 = (H * (A1-A2)/L) * γ

A1 = 49.9 FT² (TOTAL AREA)

A2 = 28 FT² (VOID AREA)

V2 = 11.30 K/FT

X2 = 2.8 FT

V2. FOOTING

V2 = H * T * γ

V2 = 3.54 K/FT

X2 = 3.2 FT

V3. CONC FILLER

V3 = H * T * γ

H = 13.1 FT

Tavg = 1.3 FT

V3 = 2.45 K/FT

X3 = 6.0 FT

V4. KNEE

V4 = H * T * γ

V4 = 0.00 K/FT

X4 = 4.2 FT

For	BL16&17	Job No.	46933	Sheet No.	
Made by	RSB/JTW	Checked by	RSB	Backchecked by	HNTB
Date	9/6/2011	Date	12/27/11	Date	

MONUMENT (FORWARD)
DETERMINE PILE LOADS FOR ABUTMENT

File: c:\caddlib\pw\jwroten\db\dms72727\[Abut_Design_Monument-FWD-RFI Thin Wall.xls]PILES - CASE 1

"BEARING" OR "FRICTION" PILE: FRICTION = 1

LOAD CASE 1-2

STRENGTH III

MONUMENT CONSTRUCTED.

WIND LOAD, PERPENDICULAR TO FRONT FACE OF MONUMENT.

(CRITICAL: BACK ROW PILE CAPACITY)

MAX HORIZONTAL LOAD FACTORS AND MAX VERTICAL LOAD FACTORS.

LOAD MODIFIER

η = 1.00

RESISTANCE FACTOR

Φ_{DYN} = 0.7

Φ_{UPLIFT} = 0.35

LOAD FACTORS

γDC = 1.25

γWS = 1.40

VERTICAL FORCES

		UNFACTORED (SERVICE LOAD)			FACTORED		
Factor	Description	ΣQ_V	(X)	ΣM_R	$\Sigma(\eta\gamma Q_V)$	(X)	$\Sigma(\eta\gamma M_R)$
DC	V1. STEM	11.30 k/ft	2.83 ft	32.02 k-ft/ft	14.13 k/ft	2.83 ft	40.02 k-ft/ft
	V2. FOOTING	3.54 k/ft	3.15 ft	11.16 k-ft/ft	4.43 k/ft	3.15 ft	13.95 k-ft/ft
	V3. CONC FILLER	2.45 k/ft	5.96 ft	14.58 k-ft/ft	3.06 k/ft	5.96 ft	18.22 k-ft/ft
	V4. KNEE	0.00 k/ft	4.17 ft	0.00 k-ft/ft	0.00 k/ft	4.17 ft	0.00 k-ft/ft
	TOTAL =	**17.3 k-ft**		**57.8 k-ft/ft**	**21.6 k-ft**		**72.2 k-ft/ft**

HORIZONTAL FORCES

		UNFACTORED (SERVICE LOAD)			FACTORED		
Factor	Description	ΣQ_H	(X)	ΣM_D	$\Sigma(\eta\gamma Q_H)$	(X)	$\Sigma(\eta\gamma M_D)$
WS	H1. WIND PRESSURE	0.84 k/ft	22.30 ft	18.63 k-ft	1.17 k/ft	22.30 ft	26.08 k-ft
	TOTAL =	**0.8 k-ft**		**18.6 k-ft/ft**	**1.2 k-ft**		**26.1 k-ft/ft**

$\Sigma M_{toe} = \Sigma M_R + \Sigma M_D$ = **76.4 k-ft/ft**

Resultant = $\Sigma M/\Sigma Q_V$ = **4.42 ft (from toe)**

$\Sigma M_{toe} = \Sigma(\eta\gamma M_R) + \Sigma(\eta\gamma M_D)$ = **98.3 k-ft/ft**

Resultant = $\Sigma M/\Sigma(\eta\gamma QV)$ = **4.55 ft (from toe)**

PILE REACTIONS

Pile type = 8

Rr = 162 k

Rr (uplift) = -81 k

Pile size and design loads per OBDM 2007 and Geotech Report

Number of piles in front row (odd) = 2

Number of piles in second row (odd) = 0

Number of piles in back row = 2

Front row pile spacing = 5.22 ft

Length of pile analysis strip = 10.83 ft

Distance to front row of piles = 1.50 ft

Distance to second row of piles = 0.00 ft

Distance to back row of piles = 4.50 ft

Centroid of piles from toe = 3.00 ft

Σd^2 and Section Moduli

	Distance to pile centroid	d^2	Section Modulus
Front row	1.50 ft	4.50 pile-ft^2	6.00 pile-ft
2nd row	0.00 ft	0.00 pile-ft^2	0.00 pile-ft
Back row	-1.50 ft	4.50 pile-ft^2	-6.00 pile-ft
	Σd^2 =	9.00 pile-ft^2	

BEARING PILES			
Type	Pile	R_R	Pile diameter
1	HP10x42	310 k	10.08 in
2	HP12x53	380 k	12.05 in
3	HP14x73	530 k	14.59 in
FRICTION PILES			
Type	Pile	R_n	Pile diameter
4	HP10x42	350 k	10.08 in
5	HP12x53	380 k	12.05 in
6	HP14x73	440 k	14.59 in
7	12" C.I.P.	330 k	12 in
8	14" C.I.P.	232 k	(Innerbelt)*
9	16" C.I.P.	450 k	16 in
10	HP16x88	540 k	(INNERBELT)

* Rn calculated using Shannon & Wilson "Estimated Axial Pile Resistance Chart".

Unfactored Condition (Service Load)

Eccentricity = e = -1.42 ft

Loads and moment per strip:

Vertical load = ΣV = 187.3 k-ft

ΣM about centroid of piles = ΣV^*e = -265.5 k-ft

Vertical pile reactions:

Front row = 2.6 k/pile

Second row = 0.0 k/pile

Back row = 91.1 k/pile

Horiz. pile reactions:

Front row batter = 99999.0

Second row batter = 99999.0

Horiz. component of front row = 0.0 k/pile

Horiz. component of second row = 0.0 k/pile

Total Horiz. component = 0.0 k/pile

Final Pile Reactions (ΣQ):

Front row (axial) = 2.6 k/pile

Second row (axial) = 0.0 k/pile

Back row = 91.1 k/pile

Factored Condition

Eccentricity = e = -1.55 ft

Loads and moment per strip:

Vertical load = ΣV = 234.2 k-ft

ΣM about centroid of piles = ΣV^*e = -362.2 k-ft

Vertical pile reactions:

Front row = -1.8 k/pile

Second row = 0.0 k/pile

Back row = 118.9 k/pile

Horiz. pile reactions:

Front row batter = 99999.0

Second row batter = 99999.0

Horiz. component of front row = 0.0 k/pile

Horiz. component of second row = 0.0 k/pile

Total Horiz. component = 0.0 k/pile

Final Pile Reactions ($\Sigma\eta\gamma Q$):

Front row (axial) = -1.8 k/pile OK

Second row (axial) = 0.0 k/pile OK

Back row = 118.9 k/pile OK

Final Pile Reactions, ($\Sigma\eta\gamma Q/\Phi$): (ULTIMATE BEARING VALUES)

Front row (axial) = -1.3 Ton/pile

Second row (axial) = 0.0 Ton/pile

Back row = 84.9 Ton/pile ← max, 85 Tons/pile

Overturn/Uplift:

OK

For	BL16&17	Job No.	46933	Sheet No.	
Made by	RSB/DTW	Checked by	RSB	Backchecked by	
Date	9/6/2011	Date	12/6-7/11	Date	

HNTB

MONUMENT (FORWARD)
DETERMINE PILE LOADS FOR ABUTMENT

File: c:\caddlib\pw\jwroten\db\dms72727\[Abut_Design_Monument-FWD-RFI Thin Wall.xls]PILES - CASE 2

"BEARING" OR "FRICTION" PILE: FRICTION
LOAD CASE 1-2: 2

STRENGTH III

MONUMENT CONSTRUCTED.

WIND LOAD, PERPENDICULAR TO FRONT FACE OF MONUMENT.
(CRITICAL: FRONT ROW PILE UPLIFT)
MAX HORIZONTAL LOAD FACTORS AND MIN VERTICAL LOAD FACTORS.

LOAD MODIFIER
η = 1.00

RESISTANCE FACTOR
Φ_{DYN} = 0.7
Φ_{UPLIFT} = 0.35

LOAD FACTORS
γDC = 0.90
γWS = 1.40

VERTICAL FORCES

		UNFACTORED (SERVICE LOAD)			FACTORED		
Factor	Description	ΣQ_V	(X)	ΣM_R	$\Sigma(\eta\gamma Q_V)$	(X)	$\Sigma(\eta\gamma M_R)$
DC	V1. STEM	11.30 k/ft	2.83 ft	32.02 k-ft/ft	10.17 k/ft	2.83 ft	28.82 k-ft/ft
	V2. FOOTING	3.54 k/ft	3.15 ft	11.16 k-ft/ft	3.19 k/ft	3.15 ft	10.05 k-ft/ft
	V3. CONC FILLER	2.45 k/ft	5.96 ft	14.58 k-ft/ft	2.20 k/ft	5.96 ft	13.12 k-ft/ft
	V4. KNEE	0.00 k/ft	4.17 ft	0.00 k-ft/ft	0.00 k/ft	4.17 ft	0.00 k-ft/ft
	TOTAL =	**17.3 k-ft**		**57.8 k-ft/ft**	**15.6 k-ft**		**52.0 k-ft/ft**

HORIZONTAL FORCES

		UNFACTORED (SERVICE LOAD)			FACTORED		
Factor	Description	ΣQ_H	(X)	ΣM_D	$\Sigma(\eta\gamma Q_H)$	(X)	$\Sigma(\eta\gamma M_D)$
WS	H1. WIND PRESSURE	0.84 k/ft	22.30 ft	18.63 k-ft	1.17 k/ft	22.30 ft	26.08 k-ft
	TOTAL =	**0.8 k-ft**		**18.6 k-ft/ft**	**1.2 k-ft**		**26.1 k-ft/ft**

$\Sigma M_{toe} = \Sigma M_R + \Sigma M_D$ = **76.4 k-ft/ft**
Resultant = $\Sigma M/\Sigma Q_V$ = **4.42 ft (from toe)**

$\Sigma M_{toe} = \Sigma(\eta\gamma M_R) + \Sigma(\eta\gamma M_D)$ = **78.1 k-ft/ft**
Resultant = $\Sigma M/\Sigma(\eta\gamma QV)$ = **5.02 ft (from toe)**

PILE REACTIONS

Pile type = 8
Rr = **162 k**
Rr (uplift) = **-81 k**

Pile size and design loads per OBDM 2007 and Geotech Report

Number of piles in front row (odd) = 2
Number of piles in second row (odd) = 0
Number of piles in back row = 2
Front row pile spacing = 5.22 ft
Length of pile analysis strip = 10.83 ft
Distance to front row of piles = 1.50 ft
Distance to second row of piles = 0.00 ft
Distance to back row of piles = 4.50 ft
Centroid of piles from toe = 3.00 ft

Σd^2 and Section Moduli

	Distance to pile centroid	d^2	Section Modulus
Front row	1.50 ft	4.50 pile-ft^2	6.00 pile-ft
2nd row	0.00 ft	0.00 pile-ft^2	0.00 pile-ft
Back row	-1.50 ft	4.50 pile-ft^2	-6.00 pile-ft
	Σd^2 =	9.00 pile-ft^2	

BEARING PILES			
Type	Pile	R_R	Pile diameter
1	HP10x42	310 k	10.08 in
2	HP12x53	380 k	12.05 in
3	HP14x73	530 k	14.59 in
FRICTION PILES			
Type	Pile	R_n	Pile diameter
4	HP10x42	350 k	10.08 in
5	HP12x53	380 k	12.05 in
6	HP14x73	440 k	14.59 in
7	12" C.I.P.	330 k	12 in
8	14" C.I.P.	232 k	(Innerbelt)*
9	16" C.I.P.	450 k	16 in
10	HP16x88	540 k	(INNERBELT)

* Rn calculated using Shannon & Wilson "Estimated Axial Pile Resistance Chart".

Unfactored Condition (Service Load)

Eccentricity = e = -1.42 ft

Loads and moment per strip:
Vertical load = ΣV = 187.3 k-ft
ΣM about centroid of piles = ΣV^*e = -265.5 k-ft

Vertical pile reactions:
Front row = 2.6 k/pile
Second row = 0.0 k/pile
Back row = 91.1 k/pile

Horiz. pile reactions:
Front row batter = 99999.0
Second row batter = 99999.0
Horiz. component of front row = 0.0 k/pile
Horiz. component of second row = 0.0 k/pile
Total Horiz. component = 0.0 k/pile

Final Pile Reactions (ΣQ):
Front row (axial) = 2.6 k/pile
Second row (axial) = 0.0 k/pile
Back row = 91.1 k/pile

Factored Condition

Eccentricity = e = -2.02 ft

Loads and moment per strip:
Vertical load = ΣV = 168.6 k-ft
ΣM about centroid of piles = ΣV^*e = -339.9 k-ft

Vertical pile reactions:
Front row = -14.5 k/pile
Second row = 0.0 k/pile
Back row = 98.8 k/pile

Horiz. pile reactions:
Front row batter = 99999.0
Second row batter = 99999.0
Horiz. component of front row = 0.0 k/pile
Horiz. component of second row = 0.0 k/pile
Total Horiz. component = 0.0 k/pile

Final Pile Reactions ($\Sigma\eta\gamma Q$):
Front row (axial) = -14.5 k/pile OK
Second row (axial) = 0.0 k/pile OK
Back row = 98.8 k/pile OK

Final Pile Reactions, ($\Sigma\eta\gamma Q/\Phi$): (ULTIMATE BEARING VALUES)
Front row (axial) = -10.4 Ton/pile
Second row (axial) = 0.0 Ton/pile
Back row = 70.6 Ton/pile

Overturn/Uplift:
OK