

Title NZT Preliminary Onshore Ground Investigation  
 Subtitle CCR & Workshops  
 Location Teesworks  
 Report No. Report No: 6065746\_ACM\_RP\_ENV **Press F9 to calculate profile**  
 Date 22/10/2021 **CALCULATED SETTLEMENTS**  
 Engineer NJ/CMC/SDM  
 Status: Version 1.061 28th January 2014 **25.12 mm**  
 Subtitle 2 Ground Profile - MS/BH13  
 Subtitle 3 Groundwater at 3.6 m OD  
 Subtitle 4

**Coordinates**  
**Stress Point**

Xp 27.50 (m)  
 Yp 64.00 (m)

**Coordinates and Loads**

Load Stage	1	2	3	4	5	6	7	8
Applied Stress (kPa)	35.00							
Current Level (mOD)	5.70							
x1 (m)	0.00							
y1 (m)	0.00							
y dimension (m)	128.000							
x dimension (m)	55.000							
z depth below ground (m)		0.00	0.00	0.00	0.00	0.00	0.00	0.00
Overburden (kPa)	10.00							
Increment for long profile (m)	1.00							

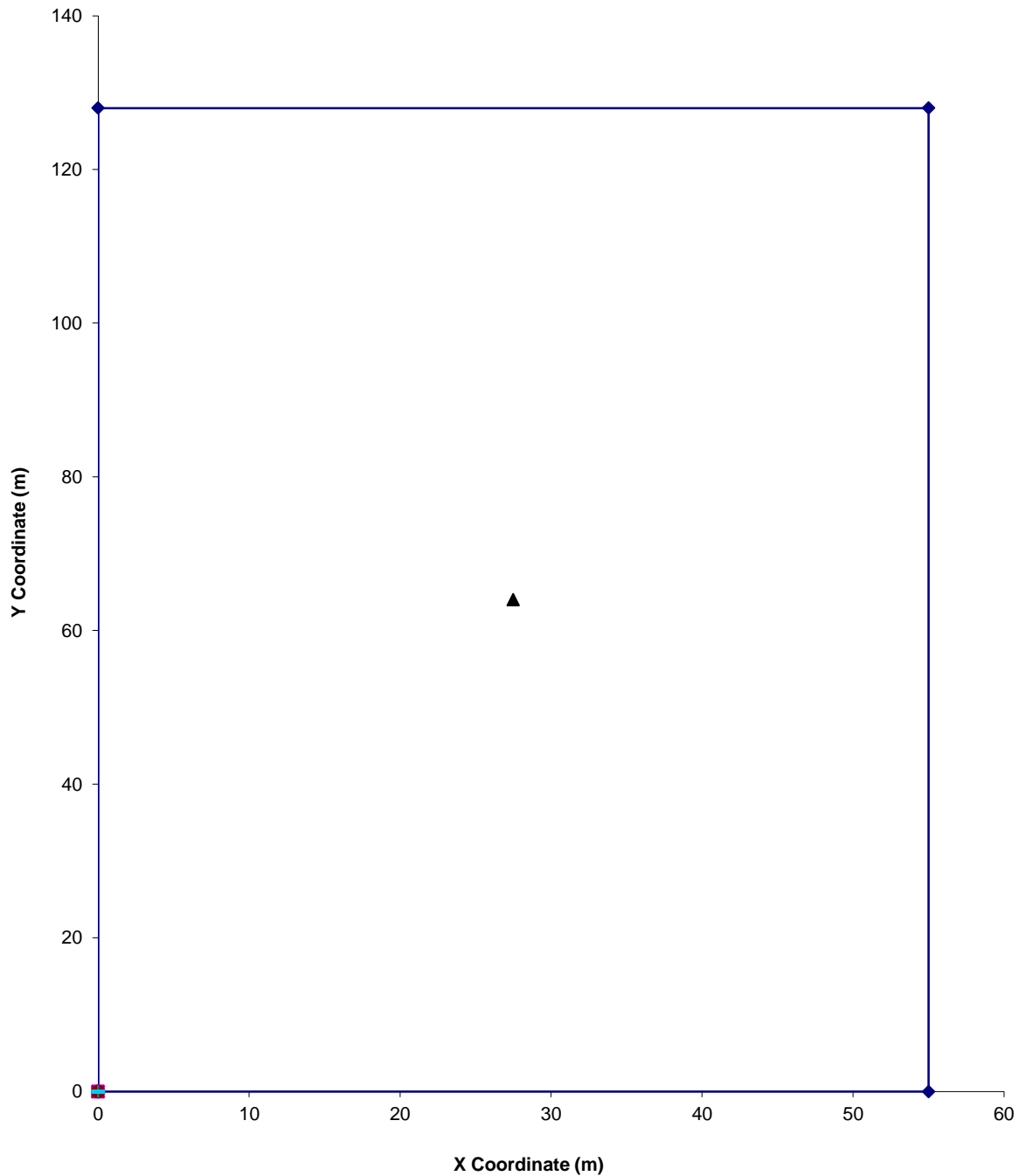
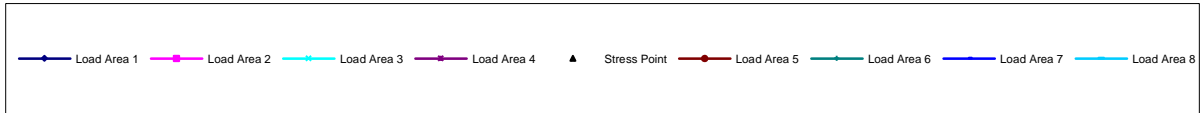
**Water Level and Weight**


Water Level (mOD) 3.60  
 Unit Weight (kN/m<sup>3</sup>) 9.81

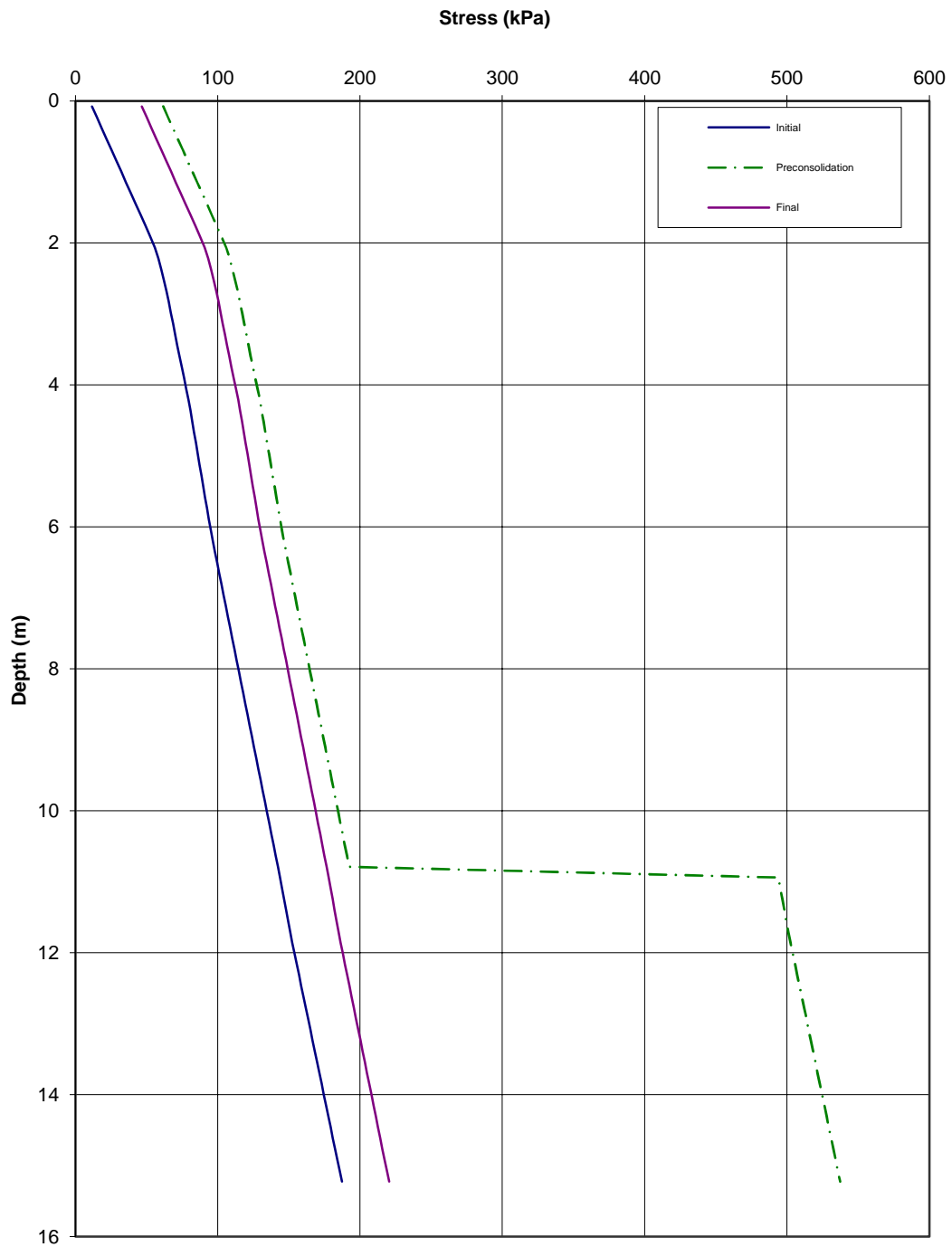
**SOIL PROPERTIES**

Initial Bed Level (mOD) 5.70 Fixed at current level  
 Total Thickness (m) 15.30

Depth Top (m)	Layer Number	Bulk Density (Mg/m <sup>3</sup> )	Dry Density (Mg/m <sup>3</sup> )	Saturated Density (Mg/m <sup>3</sup> )	Particle Density (Mg/m <sup>3</sup> )	mc above (%)	Saturated mc (%)	Void Ratio	Cs Index	Ratio Cc/Cs	Cc Index	Pc'-Po' (kPa)	Skempton Bjerrum Coefficient µ <sub>g</sub>	Description
0.00	1	2.28	2.05	2.28	2.65	11.02	11.02	0.2920	0.0050	10.0	0.0500	50.00	1.00	Made Ground - Slag dominant (d1)
2.70	2	2.00	1.61	2.00	2.65	24.00	24.34	0.6450	0.0386	7.0	0.2700	50.00	1.00	Made Ground - Soft clay (d4)
3.65	3	2.08	1.73	2.08	2.65	20.00	20.00	0.5300	0.0200	10.0	0.2000	50.00	1.00	Made Ground - Sand (hydrocarbon odour) (d2)
4.20	4	1.86	1.43	1.86	2.50	30.00	30.00	0.7500	0.0286	7.0	0.2000	50.00	1.00	Tidal Flats - Clay (soft organic) (c1)
6.05	5	2.02	1.67	2.00	2.50	21.00	20.00	0.5000	0.0200	10.0	0.2000	50.00	1.00	Tidal Flats - Sand (c2)
10.90	6	1.93	1.50	1.93	2.65	29.00	29.06	0.7700	0.0333	7.0	0.2330	350.00	1.00	Lacustrine Deposits - Laminated Clay (b3)
11.70	7	2.06	1.70	2.06	2.65	21.00	21.13	0.5600	0.0210	10.0	0.2100	350.00	1.00	Glacial Till (b1)



<p>PROJECT TITLE:- <b>NZT Preliminary Onshore Ground Investigation</b></p>	<p>ORIGINATOR:- <b>AECOM</b></p>	
<p>SKETCH / FIG TITLE:- <b>CCR &amp; Workshops</b> <b>Teesworks</b> <b>SETTLEMENT ANALYSIS</b> Ground Profile - MS/BH13 Geometry of Loaded Area and Location of Stress Profile</p>	<p>SKETCH / FIG NO.:- Figure 1</p>	
	<p>Report No: 6065746_ACM_RP_ENV</p>	
	<p>DATE:- 22/10/2021</p>	



PROJECT TITLE:-  
**NZT Preliminary Onshore Ground Investigation**

ORIGINATOR:-  
**AECOM**

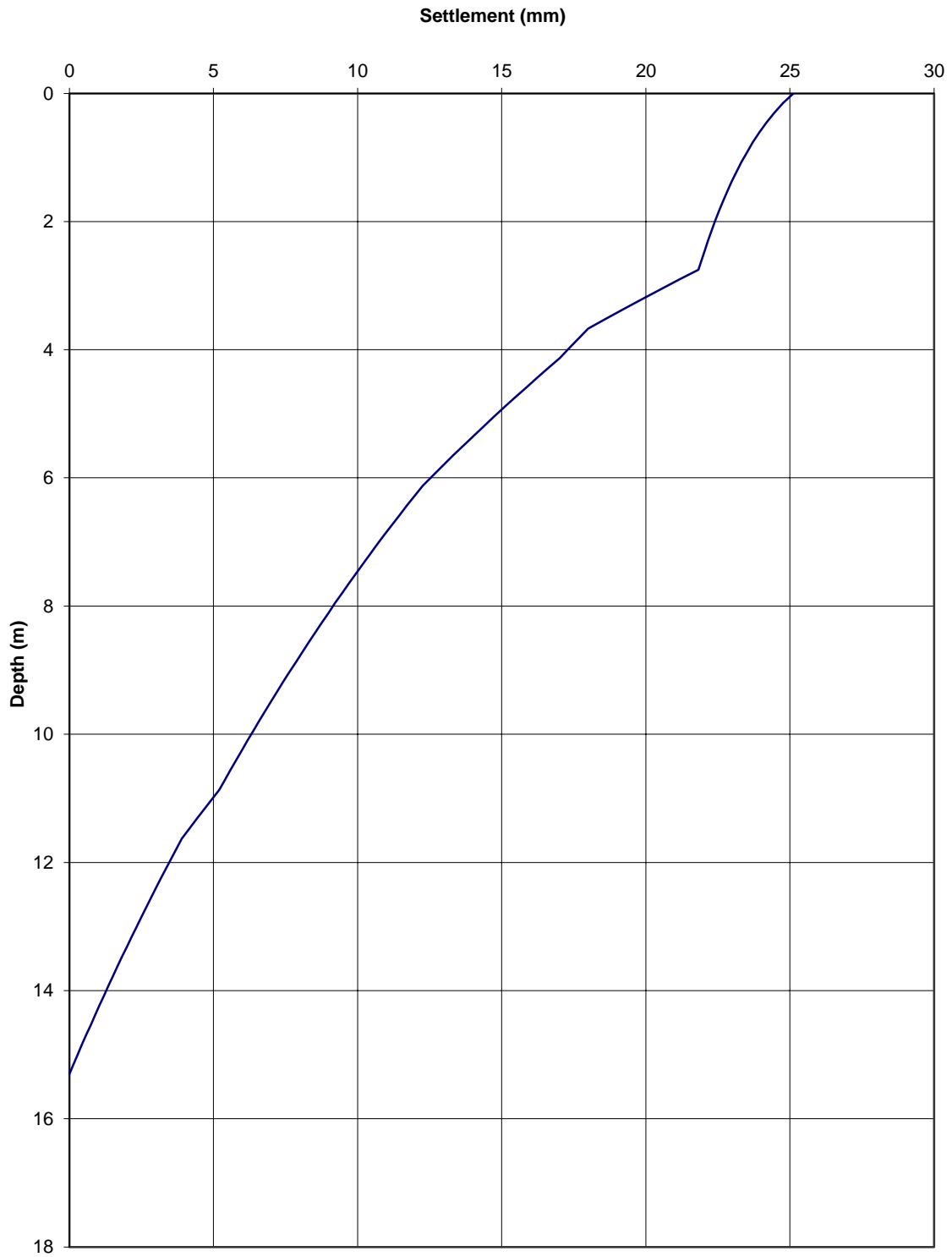
SKETCH / FIG TITLE:-  
**CCR & Workshops**  
**Teesworks**  
**SETTLEMENT ANALYSIS**  
 Ground Profile - MS/BH13  
 Stress Profiles

SKETCH / FIG No.:-  
 Figure 2

Report No:  
 6065746\_ACM\_RP\_ENV

DATE:-  
 22/10/2021





PROJECT TITLE:-  
**NZT Preliminary Onshore Ground Investigation**

ORIGINATOR:-  
**AECOM**

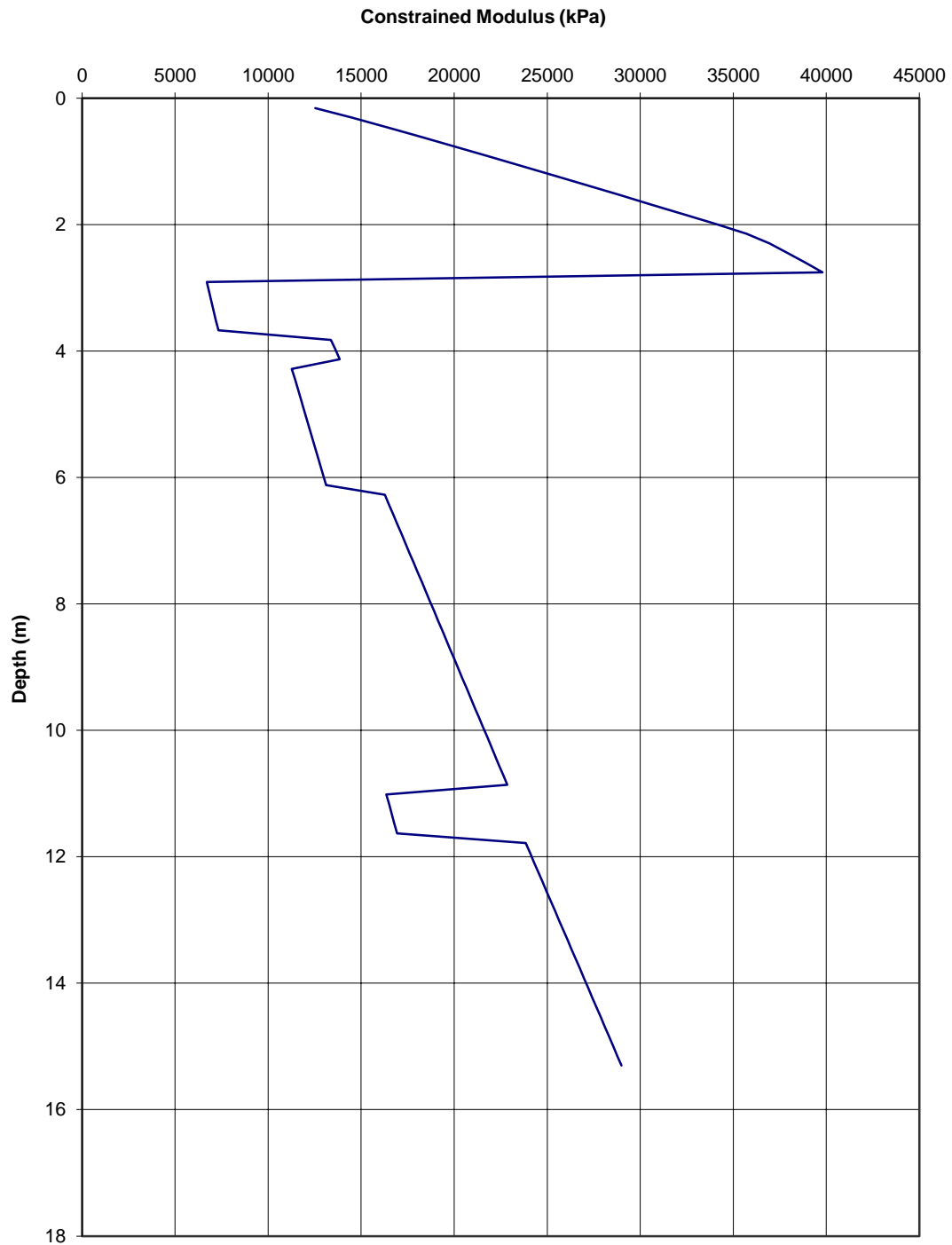
SKETCH / FIG TITLE:-  
**CCR & Workshops**  
**Teesworks**  
**SETTLEMENT ANALYSIS**  
 Ground Profile - MS/BH13  
 Displacement Profile


SKETCH / FIG No.:-  
 Figure 3

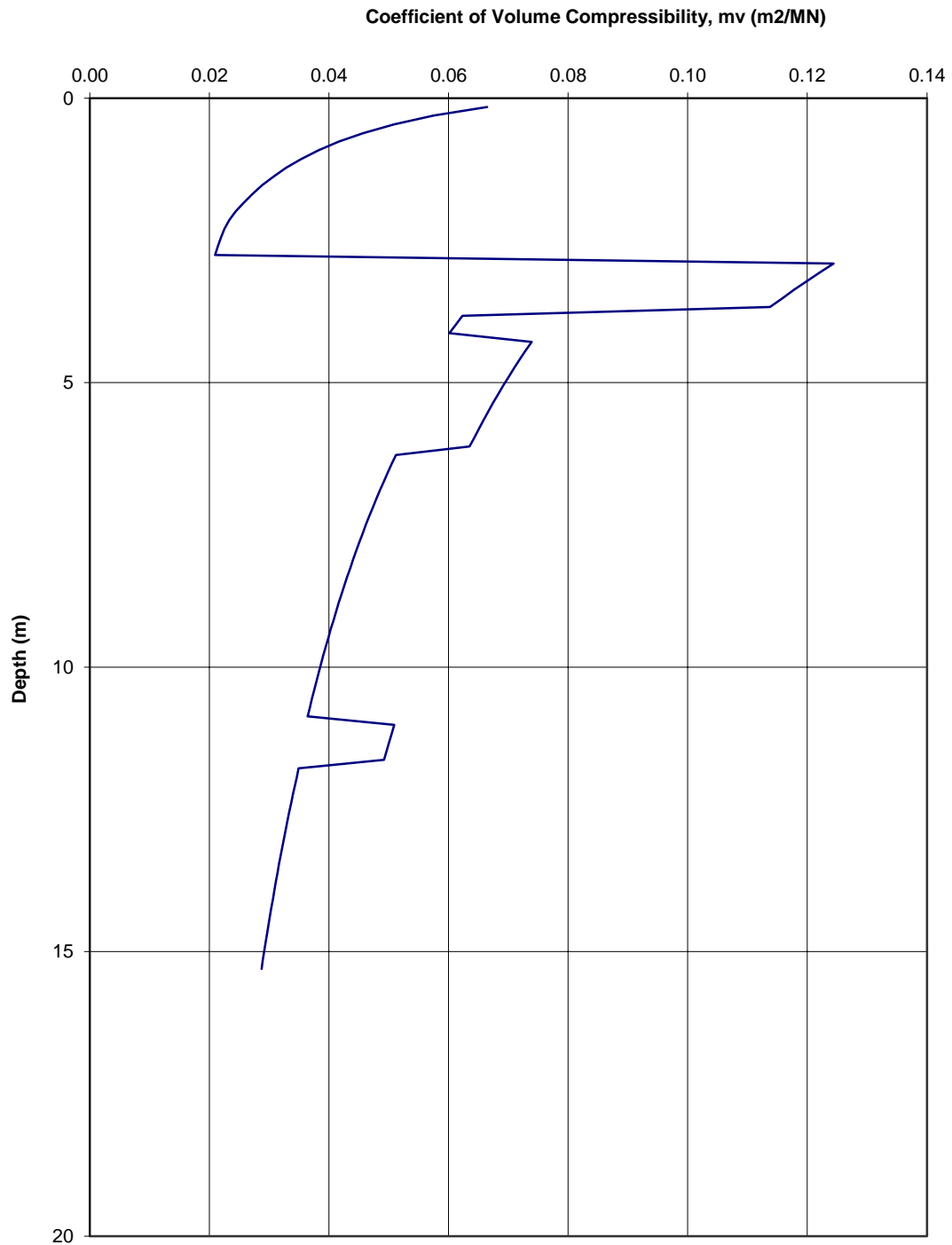
Report No:  
 6065746\_ACM\_RP\_ENV

DATE:-  
 22/10/2021





PROJECT TITLE:- <b>NZT Preliminary Onshore Ground Investigation</b>		ORIGINATOR:- <b>AECOM</b>
SKETCH / FIG TITLE:- <b>CCR &amp; Workshops</b>  <b>Teesworks</b>  <b>SETTLEMENT ANALYSIS</b>  Ground Profile - MS/BH13  Drained Soil Stiffness Profile	SKETCH / FIG No.:- Figure 4	
	Report No: 6065746_ACM_RP_ENV	
	DATE:- 22/10/2021	



PROJECT TITLE:-  
**NZT Preliminary Onshore Ground Investigation**

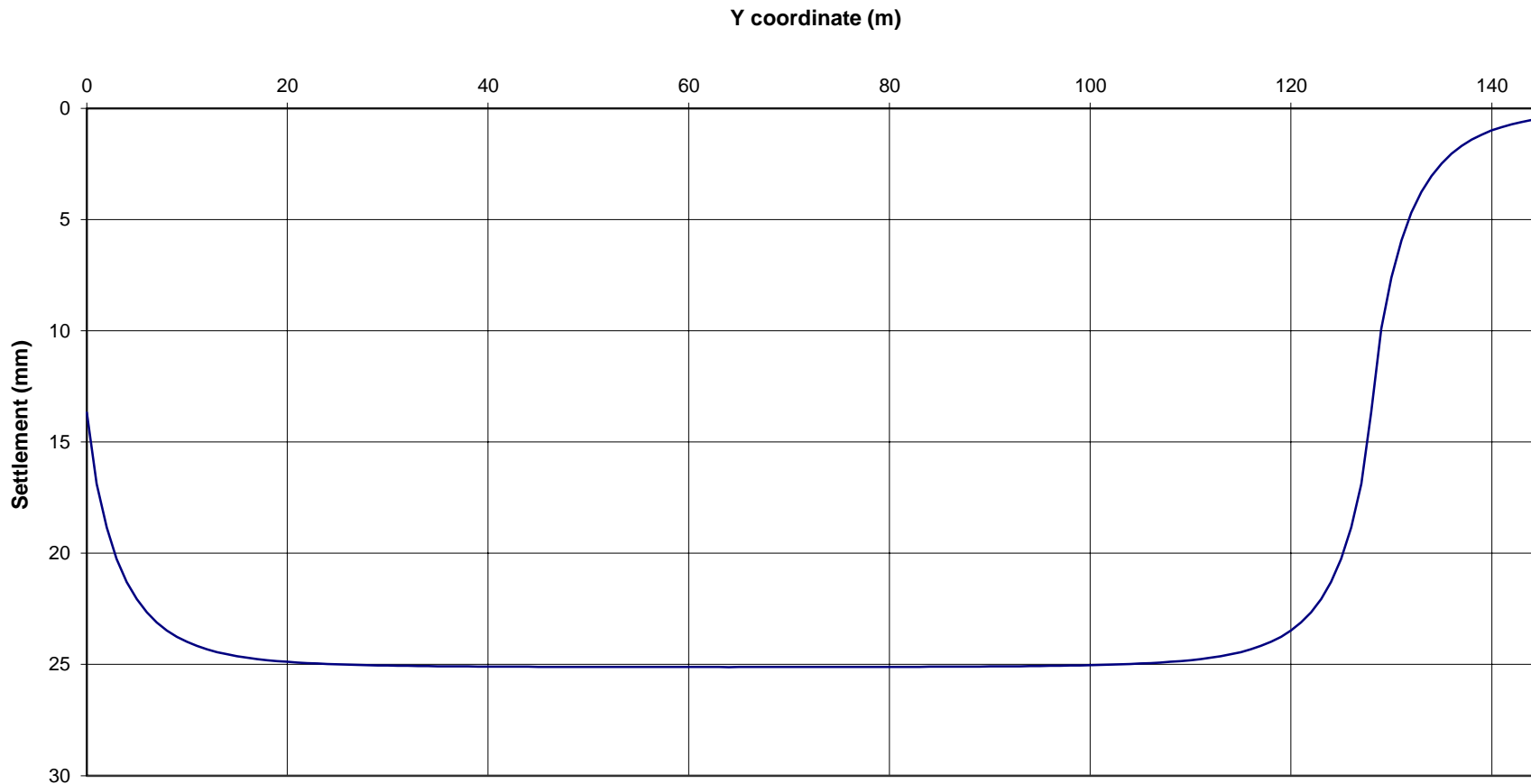
ORIGINATOR:-  
**AECOM**

SKETCH / FIG TITLE:-  
**CCR & Workshops**  
**Teesworks**  
**SETTLEMENT ANALYSIS**  
Ground Profile - MS/BH13  
mv profile

SKETCH / FIG No.:-  
Figure 5  
Report No:  
6065746\_ACM\_RP\_ENV

DATE:-  
22/10/2021





PROJECT TITLE:-  
**NZT Preliminary Onshore Ground Investigation**

SKETCH / FIG TITLE:-  
**CCR & Workshops**  
**Teesworks**  
**SETTLEMENT ANALYSIS**

Displacement along Centre Line  
 Ground Profile - MS/BH13

ORIGINATOR:-  
**AECOM**

SKETCH / FIG No.:-  
 Figure 6

Report No:  
 6065746\_ACM\_RP\_ENV

DATE:-  
 22/10/2021



CALCULATION OF AXIAL PILE CAPACITY USING THE BETA METHOD

Summary table with columns: FILE, CLIENT, JOB, SITE, LOCATION, SUBTITLE, ENGR, CHECK, DATE, Version, Date updated, Author. Includes details for project 60657467, client bp on behalf of OGC, and location MSBH08 - Cooling.

Soil Properties table with columns: FoS, Safe, Applied, kN. Values for FoS: 2.50, 3.00, 2.50, 3.00. Safe: 1414.07, 848.23, 2262.30. Applied: 1500.00, 500.00, 2000.00.



INPUT INFORMATION table with columns: Existing ground level, Finished formation level, Embedment below cut off, etc.

Soil Properties table with columns: Layer, Depth, Bulk Density, Friction Angle, Cohesion, Interface Factor, etc.

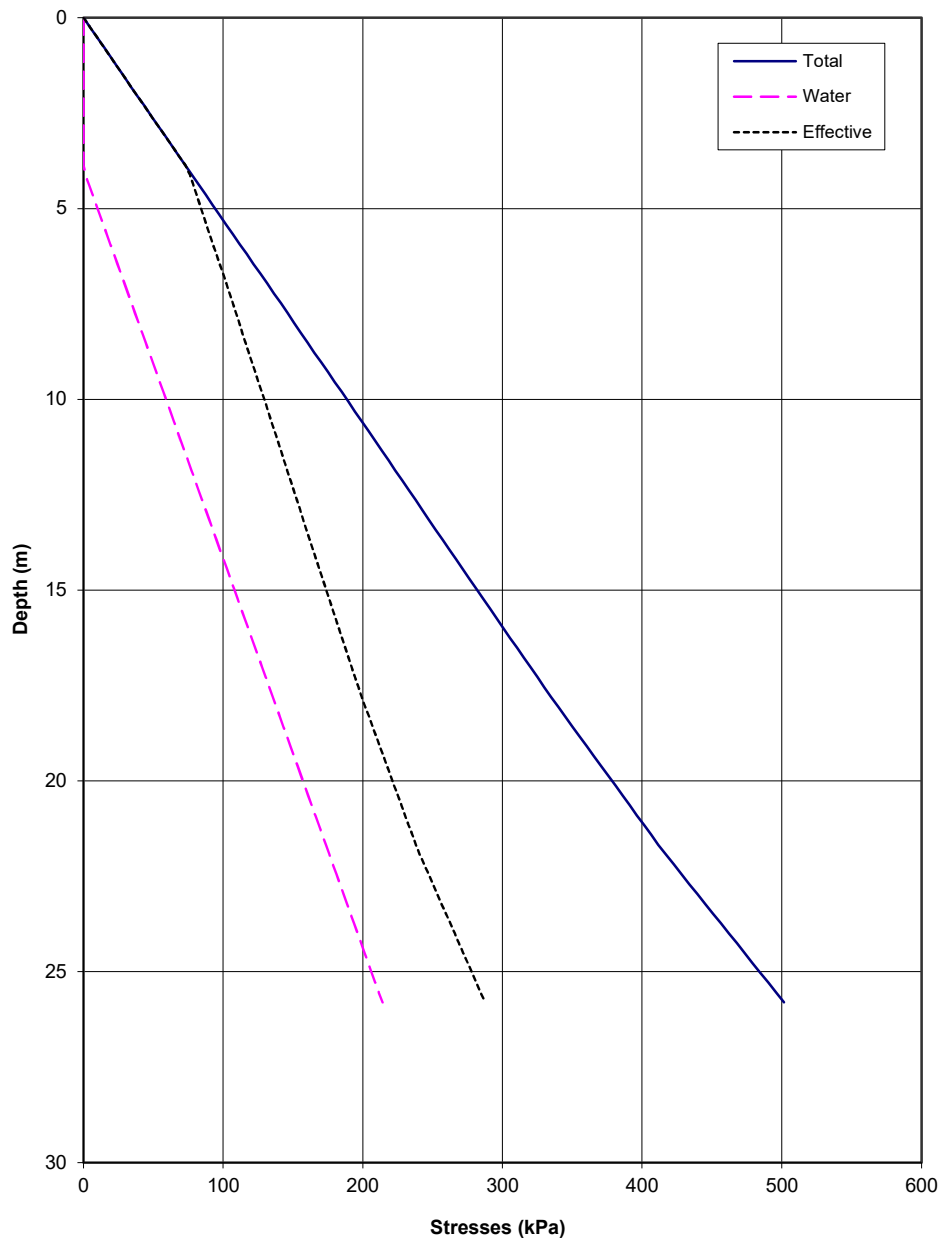
Table with columns: Top, Depth, Bulk Density, Friction Angle, Cohesion, Interface Factor, etc.

Main calculation table with 28 columns: Depth below, Soil, Bulk Density, Total Stress, Artesian Gradient, Water Stress, Effective Stress, Cohesion, Friction Angle, Interface Factor, Preload Stress, OCR value, K nc, K p, Triaxial Comp Strength, Uniaxial Comp Strength, Ko OC K, Beta Factor, UCS alpha rock, Neq Factor, Ultimate Skin Friction, Ultimate Shaft Capacity, Ultimate Top Capacity, Ultimate Toe Capacity, Dead Load Drag, Ultimate Tens Skin, Net Force in Pile, Working Stress, Maximum Allowable Stress, Incr. Comp, Working Comp.

Limiting Ko OC Values table with columns: Soil Type, File Type, Calculation Reference, Maximum Value.



circular concrete 0.6 m pile



PROJECT TITLE:-  
**Net Zero Teesside**



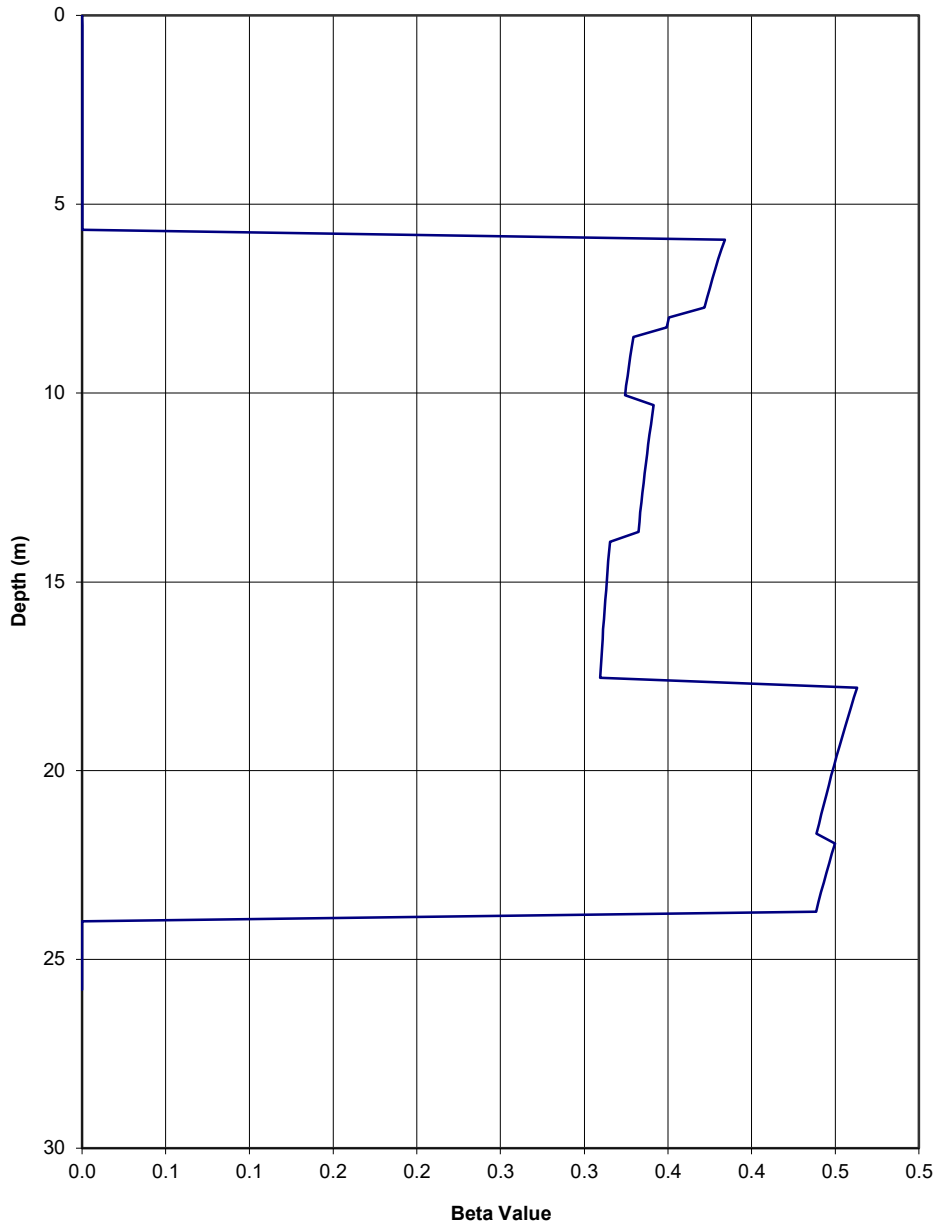
FIGURE TITLE:-  
**Preliminary Onshore Ground  
MS\BH08 - Cooling**  
600mm dia. concrete Bored piles 2m rock  
CALCULATION OF AXIAL PILE CAPACITY USING THE BETA METHOD  
  
Vertical Stress Profiles

FIGURE No.  
Figure 1

REPORT No.:  
60657467

DATE:-  
02-Nov-21

circular concrete 0.6 m pile



PROJECT TITLE:-  
**Net Zero Teesside**



FIGURE TITLE:-  
**Preliminary Onshore Ground Investigation  
MSIBH08 - Cooling**

600mm dia. concrete Bored piles 2m rock

CALCULATION OF AXIAL PILE CAPACITY USING THE BETA METHOD

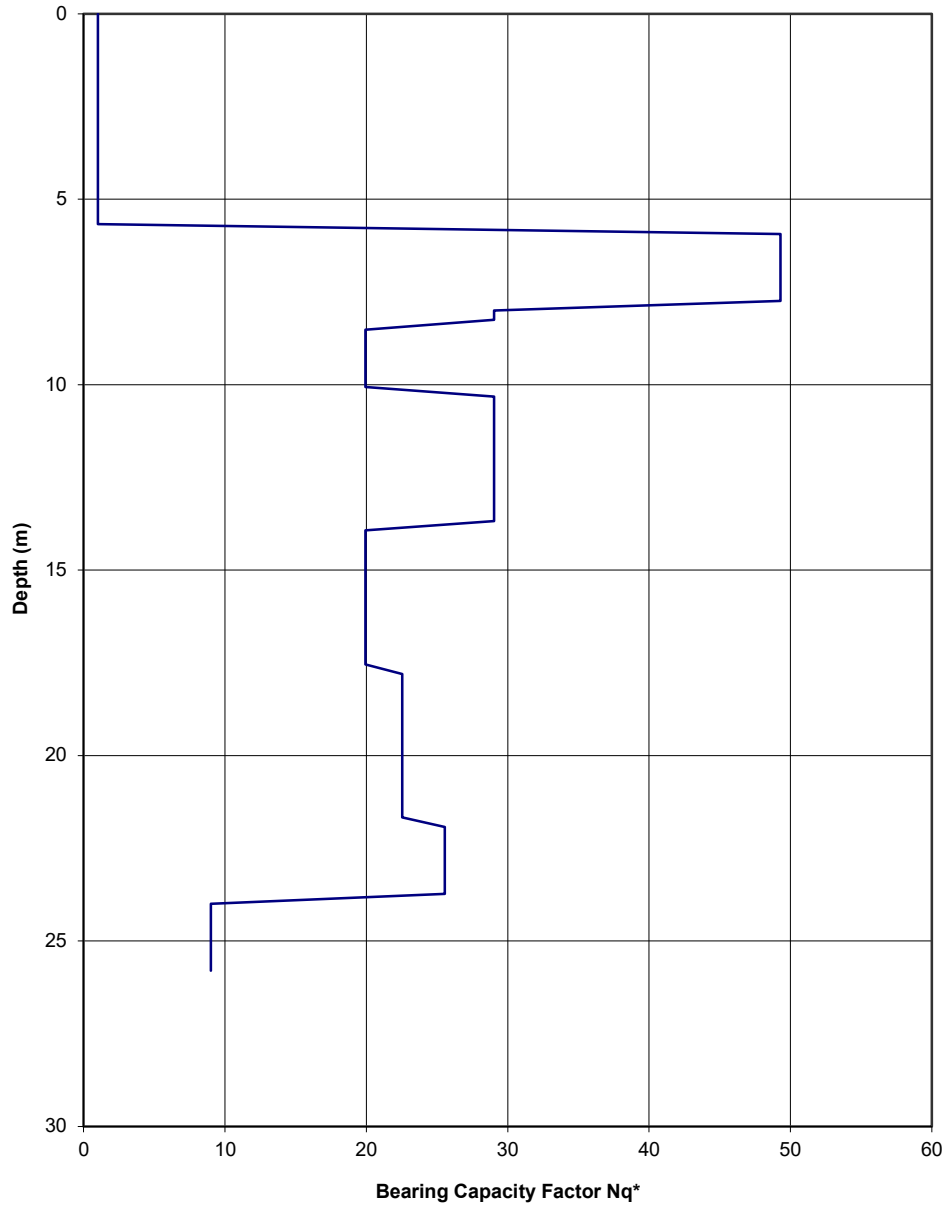
Beta Values

FIGURE No.:  
Figure 2

REPORT No.:  
60657467

DATE:-  
02-Nov-21

circular concrete 0.6 m pile



PROJECT TITLE:-  
**Net Zero Teesside**



FIGURE TITLE:-  
**Preliminary Onshore Ground Investigation**  
**MS\BH08 - Cooling**

600mm dia. concrete Bored piles 2m rock

CALCULATION OF AXIAL PILE CAPACITY USING THE BETA METHOD

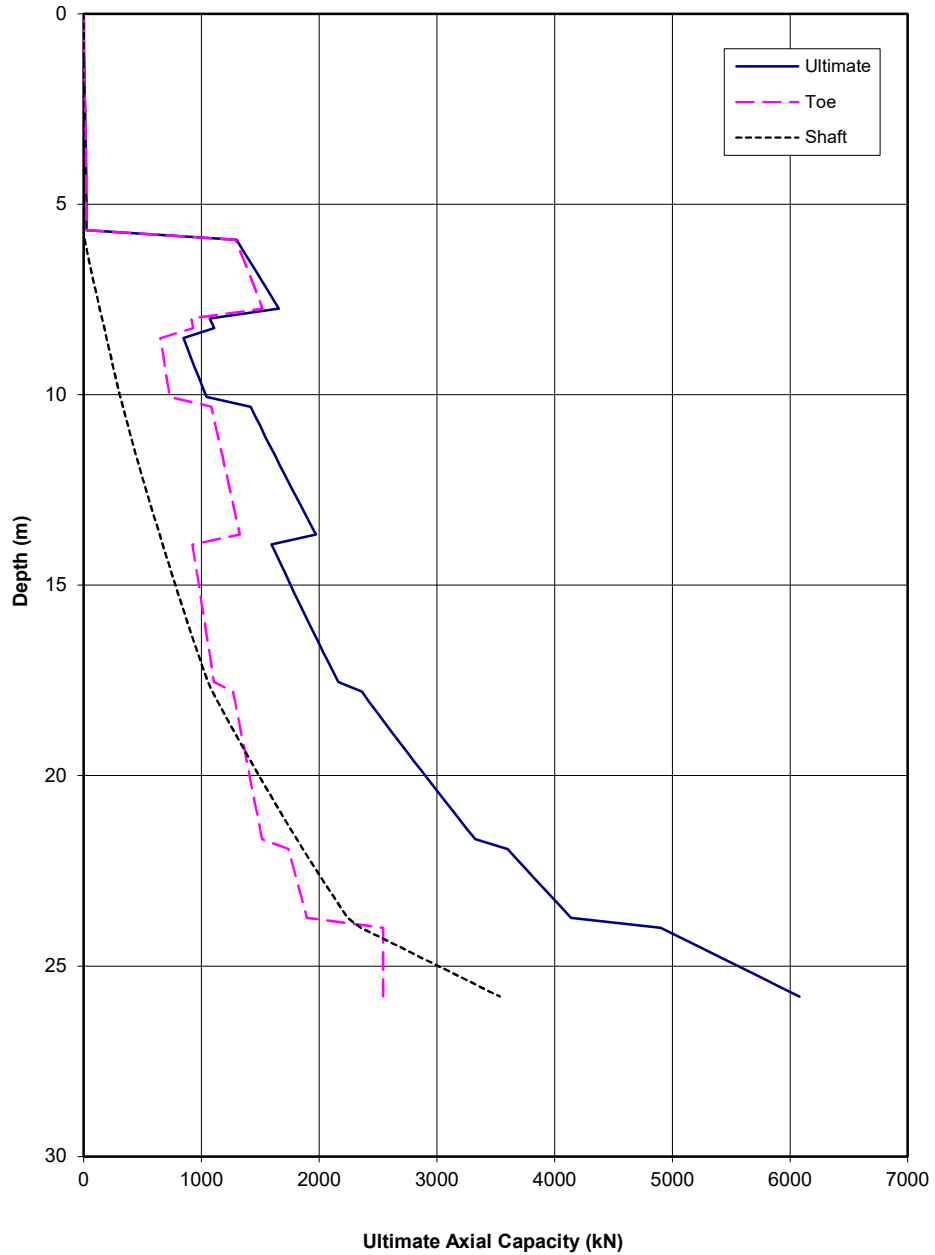
$N_q^*$  Values

FIGURE No.:  
Figure 4

REPORT No.:  
60657467

DATE:-  
02-Nov-21

circular concrete 0.6 m pile



PROJECT TITLE:-  
**Net Zero Teesside**



FIGURE TITLE:-  
**Preliminary Onshore Ground  
MSBH08 - Cooling**  
600mm dia. concrete Bored piles 2m rock  
CALCULATION OF AXIAL PILE CAPACITY USING THE BETA METHOD  
Ultimate Axial Pile Capacity

FIGURE No.:  
Figure 8

REPORT No:-  
60657467

DATE:-  
02-Nov-21

Calculation of Axial Pile Capacity Using the Beta Method

FILE :	60657467	Summary	circular concrete 0.75 m pile	
CLIENT :	bp on behalf of OGCI		FoS	Safe
JOB :	Net Zero Teesside	Skin	4418.96	kN
SITE :	Preliminary Onshore Ground Investigation	Toe	3976.08	kN
LOCATION :	MSBH08 - Cooling	Total	8395.04	kN
SUBTITLE :	750mm dia. concrete Bored piles 2m rock socket	Top Stress	19.00	N/mm <sup>2</sup>
ENGR :	CMC	Stress Ratio	0.54	
CHECK :	SDM /NJ	Head settlement	10.75	mm
DATE :	02-Nov-21	Spring stiffness	279159	N/m
Version	1.125			
Date updated:	12/09/14			
Author :	sdm			



**INPUT INFORMATION**

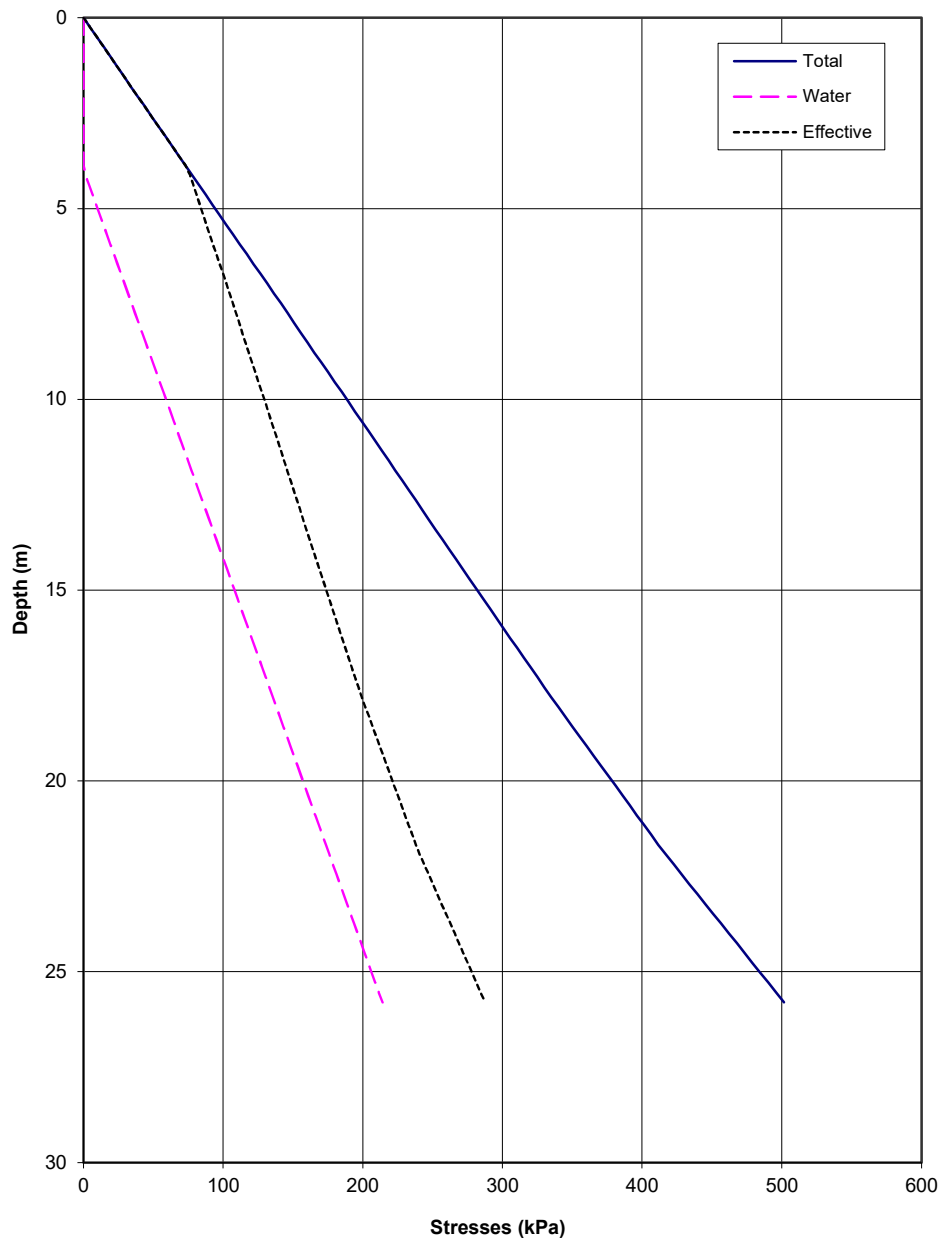
Existing ground level	7.98	mOD
Finished formation level	6.98	mOD
Pile cut off level	6.98	mOD
Embedment below cut off	25.80	m
Pile Top Level	-18.82	mOD
Depth below finished ground	25.80	m
Pile Type	circular	
Installation Method:	bored	
Depth Water:	3.98	m
Unit Weight Water:	9.81	kN/m <sup>3</sup>
Pile Diameter:	0.750	m
:	0.000	m
Pile Base Area:	0.000	m <sup>2</sup>
Shaft perimeter area	2.35619	sq.m/m
Surcharge:	0.00	kPa
Volume pile material	11.3981	m <sup>3</sup>
Compressive Strength:	35.00	N/mm <sup>2</sup>
Pile Modulus	3.5000E+07	(kPa)
Material:	concrete	
Pile material section area	0.44179	sq.m

Soil Properties

Layer Number	Pile Depth (m)	Bulk Density (Mg/m3)	Friction Angle (deg)	Cohesion (kPa)	Interface Factor	Preload Stress (kPa)	Artesian Gradient	Material Type	Description
1	1.920	0.01	0.00	0.00	1.00	50.00	1.00	soil	d1 Made Ground - Slag dominant
2	5.90	1.950	34.00	0.00	1.00	50.00	1.00	soil	d2 Made Ground - Silty Sand
3	7.20	1.900	34.00	0.00	1.00	50.00	1.00	soil	d3 Made Ground - Gravel
4	7.80	1.900	30.00	0.00	1.00	50.00	1.00	soil	c2 Tidal Flats - Sand
5	8.50	1.920	27.00	0.00	1.00	50.00	1.00	soil	c1 Tidal Flats - Clay (soft organic)
6	10.20	1.900	30.00	0.00	1.00	50.00	1.00	soil	c2 Tidal Flats - Sand
7	13.80	1.920	27.00	0.00	1.00	50.00	1.00	soil	c1 Tidal Flats - Clay
8	17.80	2.020	28.00	0.00	1.00	350.00	1.00	soil	b3 Lacustrine Deposits - Laminated Clay
9	21.80	2.230	29.00	0.00	1.00	350.00	1.00	soil	b1 Glacial Till
10	23.80	2.230	0.00	1500.00	1.00	600.00	1.00	rock	a3 Redcar Mudstone Formation

Depth below (m)	Soil/Rock	Bulk Density (Mg/m <sup>3</sup> )	Total Stress (kPa)	Artesian Gradient	Water Stress (kPa)	Effective Stress (kPa)	Cohesion (kPa)	Friction Angle (degrees)	Interface Factor	Preload Stress (kPa)	OCR value	K n/c	K p	Triaxial Compr Strength (MPa)	Uniaxial Compr Strength (MPa)	Ko OC K	Beta Factor	Ucs alpha	Ucs Factor	Ultimate Skin Friction (kPa)	Ultimate Shaft Capacity (kN)	Ultimate Toe Capacity (kN)	Ultimate Axial Capacity (kN)	Dead Load Drag (kN)	Ultimate Skin (kN)	Nett Force in Pile (kN)	Working Stress (N/mm <sup>2</sup> )	Maximum Allowable Stress (N/mm <sup>2</sup> )	Incr. Pile Compr. (mm)	Working Pile Compr (mm)	
0.00	soil	1.92	0.00	1.00	0.00	0.00	0.00	0.01	1.00	50.00	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	2500.00	8395.04	2500.00	5.68	14.00	0.0417	5.75
0.26	soil	1.92	4.86	1.00	0.00	4.86	0.00	0.01	1.00	50.00	11.29	1.00	1.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	4.86	2.15	2.15	2500.00	8395.04	2500.00	5.68	14.00	0.0417	5.70
0.52	soil	1.92	9.72	1.00	0.00	9.72	0.00	0.01	1.00	50.00	22.58	1.00	1.00	0.01	0.00	1.00	1.00	0.00	1.00	0.00	0.00	9.73	4.30	4.30	2500.00	8395.04	2500.00	5.68	14.00	0.0417	5.66
0.77	soil	1.92	14.58	1.00	0.00	14.58	0.00	0.01	1.00	50.00	33.87	1.00	1.00	0.01	0.00	1.00	1.00	0.00	1.00	0.00	0.00	14.59	6.45	6.45	2500.00	8395.04	2500.00	5.68	14.00	0.0417	5.62
1.03	soil	1.92	19.44	1.00	0.00	19.44	0.00	0.01	1.00	50.00	45.16	1.00	1.00	0.01	0.00	1.00	1.00	0.00	1.00	0.00	0.00	19.45	8.60	8.60	2500.00	8395.03	2500.00	5.68	14.00	0.0417	5.58
1.29	soil	1.92	24.30	1.00	0.00	24.30	0.00	0.01	1.00	50.00	56.45	1.00	1.00	0.02	0.00	1.00	1.00	0.00	1.00	0.00	0.01	24.32	10.75	10.75	2500.01	8395.03	2500.01	5.68	14.00	0.0417	5.54
1.55	soil	1.92	29.16	1.00	0.00	29.16	0.00	0.01	1.00	50.00	67.74	1.00	1.00	0.03	0.00	1.00	1.00	0.00	1.00	0.01	0.01	29.19	12.89	12.89	2500.01	8395.03	2500.01	5.68	14.00	0.0417	5.50
1.81	soil	1.92	34.02	1.00	0.00	34.02	0.00	0.01	1.00	50.00	79.03	1.00	1.00	0.04	0.00	1.00	1.00	0.00	1.00	0.01	0.01	34.05	15.04	15.06	2500.01	8395.02	2500.01	5.68	14.00	0.0417	5.45
2.06	soil	1.92	38.88	1.00	0.00	38.88	0.00	0.01	1.00	50.00	90.32	1.00	1.00	0.05	0.00	1.00	1.00	0.00	1.00	0.01	0.01	38.92	17.19	17.21	2500.02	8395.02	2500.02	5.68	14.00	0.0417	5.41
2.32	soil	1.92	43.74	1.00	0.00	43.74	0.00	0.01	1.00	50.00	101.61	1.00	1.00	0.06	0.00	1.00	1.00	0.00	1.00	0.01	0.02	43.78	19.34	19.36	2500.02	8395.02	2500.02	5.68	14.00	0.0417	5.37
2.58	soil	1.92	48.59	1.00	0.00	48.59	0.00	0.01	1.00	50.00	112.90	1.00	1.00	0.07	0.00	1.00	1.00	0.00	1.00	0.01	0.03	48.65	21.49	21.52	2500.03	8395.01	2500.03	5.68	14.00	0.0417	5.33
2.84	soil	1.92	53.45	1.00	0.00	53.45	0.00	0.01	1.00	50.00	124.19	1.00	1.00	0.08	0.00	1.00	1.00	0.00	1.00	0.01	0.03	53.51	23.64	23.67	2500.03	8395.01	2500.03	5.68	14.00	0.0417	5.29
3.10	soil	1.92	58.31	1.00	0.00	58.31	0.00	0.01	1.00	50.00	135.48	1.00	1.00	0.09	0.00	1.00	1.00	0.00	1.00	0.01	0.04	58.38	25.79	25.83	2500.04	8395.00	2500.04	5.68	14.00	0.0417	5.25
3.35	soil	1.92	63.17	1.00	0.00	63.17	0.00	0.01	1.00	50.00	146.77	1.00	1.00	0.10	0.00	1.00	1.00	0.00	1.00	0.01	0.04	63.24	27.94	27.98	2500.04	8394.99	2500.04	5.68	14.00	0.0417	5.20
3.61	soil	1.92	68.03	1.00	0.00	68.03	0.00	0.01	1.00	50.00	158.06	1.00	1.00	0.11	0.00	1.00	1.00	0.00	1.00	0.01	0.05	68.11	30.09	30.14	2500.05	8394.99	2500.05	5.68	14.00	0.0417	5.16
3.87	soil	1.92	72.89	1.00	0.00	72.89	0.00	0.01	1.00	50.00	169.35	1.00	1.00	0.12	0.00	1.00	1.00	0.00	1.00	0.01	0.05	72.97	32.24	32.30	2500.06	8394.98	2500.06	5.68	14.00	0.0417	5.12
4.13	soil	1.92	77.75	1.00	0.00	77.75	0.00	0.01	1.00	50.00	180.64	1.00	1.00	0.13	0.00	1.00	1.00	0.00	1.00	0.01	0.07	77.82	34.39	34.45	2500.07	8394.97	2500.07	5.68	14.00	0.0417	5.08
4.39	soil	1.92	82.61	1.00	0.00	82.61	0.00	0.01	1.00	50.00	191.93	1.00	1.00	0.14	0.00	1.00	1.00	0.00	1.00	0.01	0.07	82.71	36.54	36.60	2500.07	8394.96	2500.07	5.68	14.00	0.0417	5.04
4.64	soil	1.92	87.47	1.00	0.00	87.47	0.00	0.01	1.00	50.00	203.22	1.00	1.00	0.15	0.00	1.00	1.00	0.00	1.00	0.01	0.08	87.54	38.69	38.75	2500.08	8394.95	2500.08	5.68	14.00	0.0417	5.00
4.90	soil	1.92	92.33	1.00	0.00	92.33	0.00	0.01	1.00	50.00	214.51	1.00	1.00	0.16	0.00	1.00	1.00	0.00	1.00	0.01	0.08	92.38	40.84	40.90	2500.08	8394.95	2500.08	5.68	14.00	0.0417	4.96
5.16	soil	1.92	97.19	1.00	0.00	97.19	0.00	0.01	1.00	50.00	225.80	1.00	1.00	0.17	0.00	1.00	1.00	0.00	1.00	0.01	0.10	97.26	42.99	43.05	2500.10	8394.94	2500.10	5.68	14.00	0.0417	4.91
5.42	soil	1.92	102.05	1.00	0.00	102.05	0.00	0.01	1.00	50.00	237.09	1.00	1.00	0.18	0.00	1.00	1.00	0.00	1.00	0.02	0.11	102.15	45.14	45.20	2500.11	8394.93	2500.11	5.68	14.00	0.0417	4.87
5.68	soil	1.92	106.91	1.00	0.00	106.91	0.00	0.01	1.00	50.00	248.38	1.00	1.00	0.19	0.00	1.00	1.00	0.00	1.00	0.02	0.12	106.21	47.29	47.35	2500.12	8394.92	2500.12	5.68	14.00	0.0417	4.83
5.93	soil	1.92	111.77	1.00	0.00	111.77	0.00	0.01	1.00	50.00	259.67	1.00	1.00	0.20	0.00	1.00	1.00	0.00	1.00	0.03	0.13	111.84	49.44	49.50	2500.12	8394.91	2500.12	5.68	14.00	0.0417	4.79
6.19	soil	1.92	116.64	1.00	0.00	116.64	0.00	0.01	1.00	50.00	270.96	1.00	1.00	0.21	0.00	1.00	1.00	0.00	1.00	0.04	0.14	116.71	51.59	51.65	2500.12	8394.90	2500.12	5.68	14.00	0.0417	4.75
6.45	soil	1.92	121.50	1.00	0.00	121.50	0.00	0.01	1.00	50.00	282.25	1.00	1.00	0.22	0.00	1.00	1.00	0.00	1.00	0.05	0.15	121.58	53.74	53.80	2500.12	8394.89	2500.12	5.68	14.00	0.0417	4.71
6.71	soil	1.92	126.37	1.00	0.00	126.37	0.00	0.01	1.00	50.00	293.54	1.00	1.00	0.23	0.00	1.00	1.00	0.00	1.00	0.06	0.16	126.41	55.89	55.95	2500.12	8394.88	2500.12	5.68	14.00	0.0417	4.67
6.97	soil	1.92	131.23	1.00	0.00	131.23	0.00	0.01	1.00	50.00	304.83	1.00	1.00	0.24	0.00	1.00	1.00	0.00	1.00	0.07	0.17	131.27	58.04	58.10	2500.12	8394.87	2500.12	5.68	14.00	0.0417	4.63
7.22	soil	1.92	136.10	1.00	0.00	136.10	0.00	0.01	1.00	50.00	316.12	1.00	1.00	0.25	0.00	1.00	1.00	0.00	1.00	0.08	0.18	136.16	60.19	60.25	2500.12	8394.86	2500.12	5.68	14.00	0.0417	4.59
7.48	soil	1.92	140.96	1.00	0.00	140.96	0.00	0.01	1.00	50.00	327.41	1.00	1.00	0.26	0.00	1.00	1.00	0.00	1.00	0.09	0.19										

circular concrete 0.75 m pile



PROJECT TITLE:-  
Net Zero Teesside



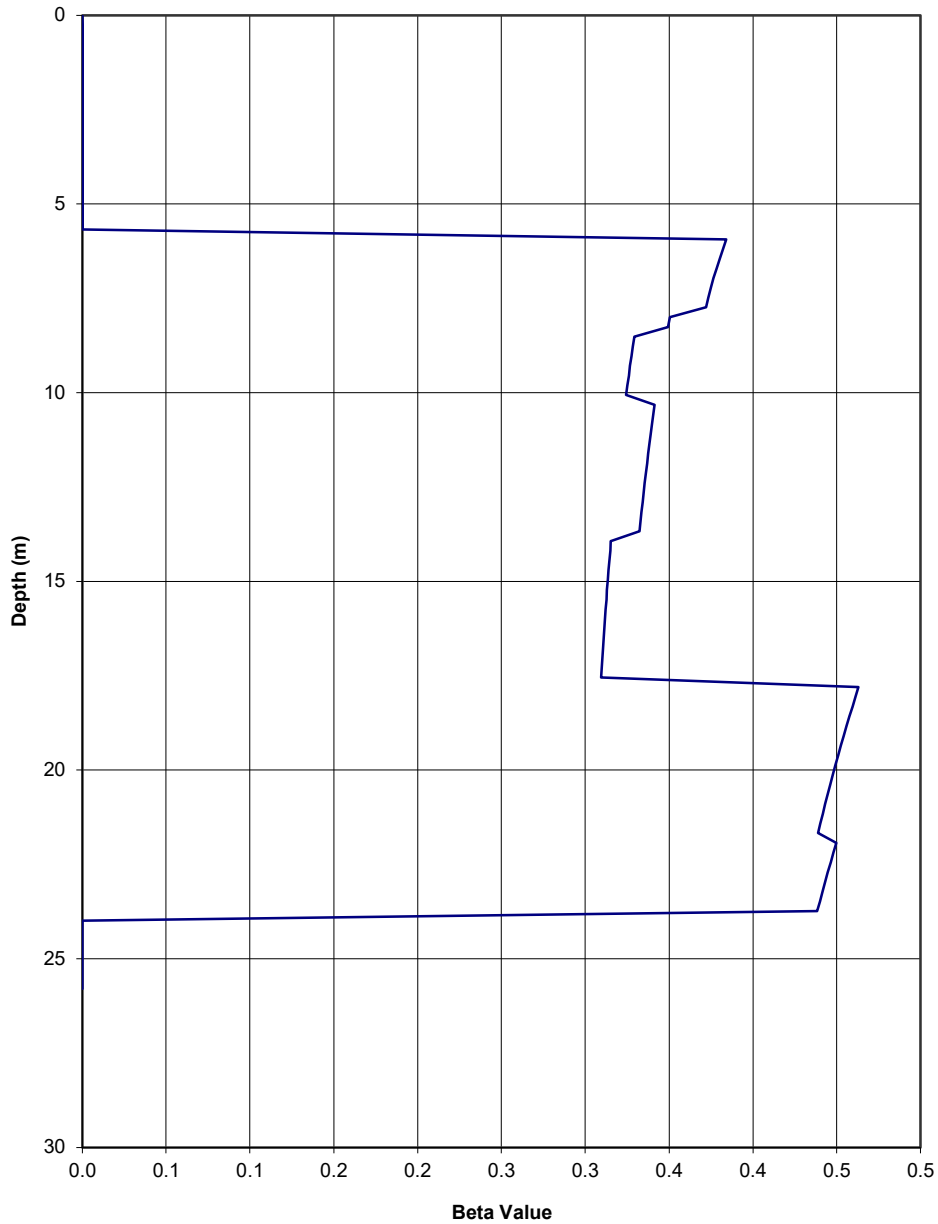
FIGURE TITLE:-  
**Preliminary Onshore Ground  
MS\BH08 - Cooling**  
750mm dia. concrete Bored piles 2m rock  
CALCULATION OF AXIAL PILE CAPACITY USING THE BETA METHOD  
  
Vertical Stress Profiles

FIGURE No.  
Figure 1

REPORT No.:  
60657467

DATE:-  
02-Nov-21

circular concrete 0.75 m pile



PROJECT TITLE:-

**Net Zero Teesside**



FIGURE TITLE:-

**Preliminary Onshore Ground Investigation  
MSBH08 - Cooling**

750mm dia. concrete Bored piles 2m rock

CALCULATION OF AXIAL PILE CAPACITY USING THE BETA METHOD

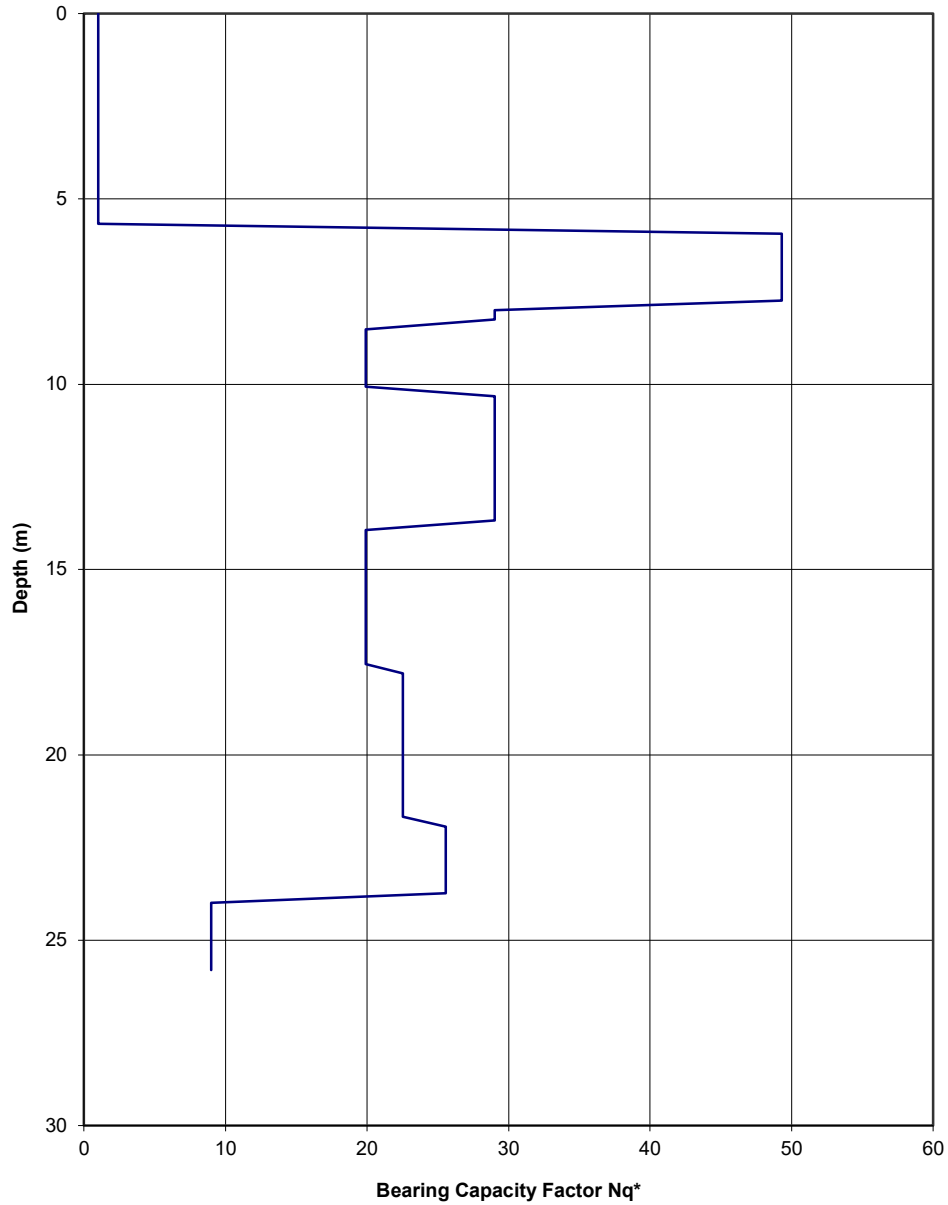
Beta Values

FIGURE No.:  
Figure 2

REPORT No.:  
60657467

DATE:-  
02-Nov-21

circular concrete 0.75 m pile



PROJECT TITLE:-  
**Net Zero Teesside**



FIGURE TITLE:-  
**Preliminary Onshore Ground Investigation**  
**MS\BH08 - Cooling**  
750mm dia. concrete Bored piles 2m rock  
CALCULATION OF AXIAL PILE CAPACITY USING THE BETA METHOD

FIGURE No.:  
Figure 4

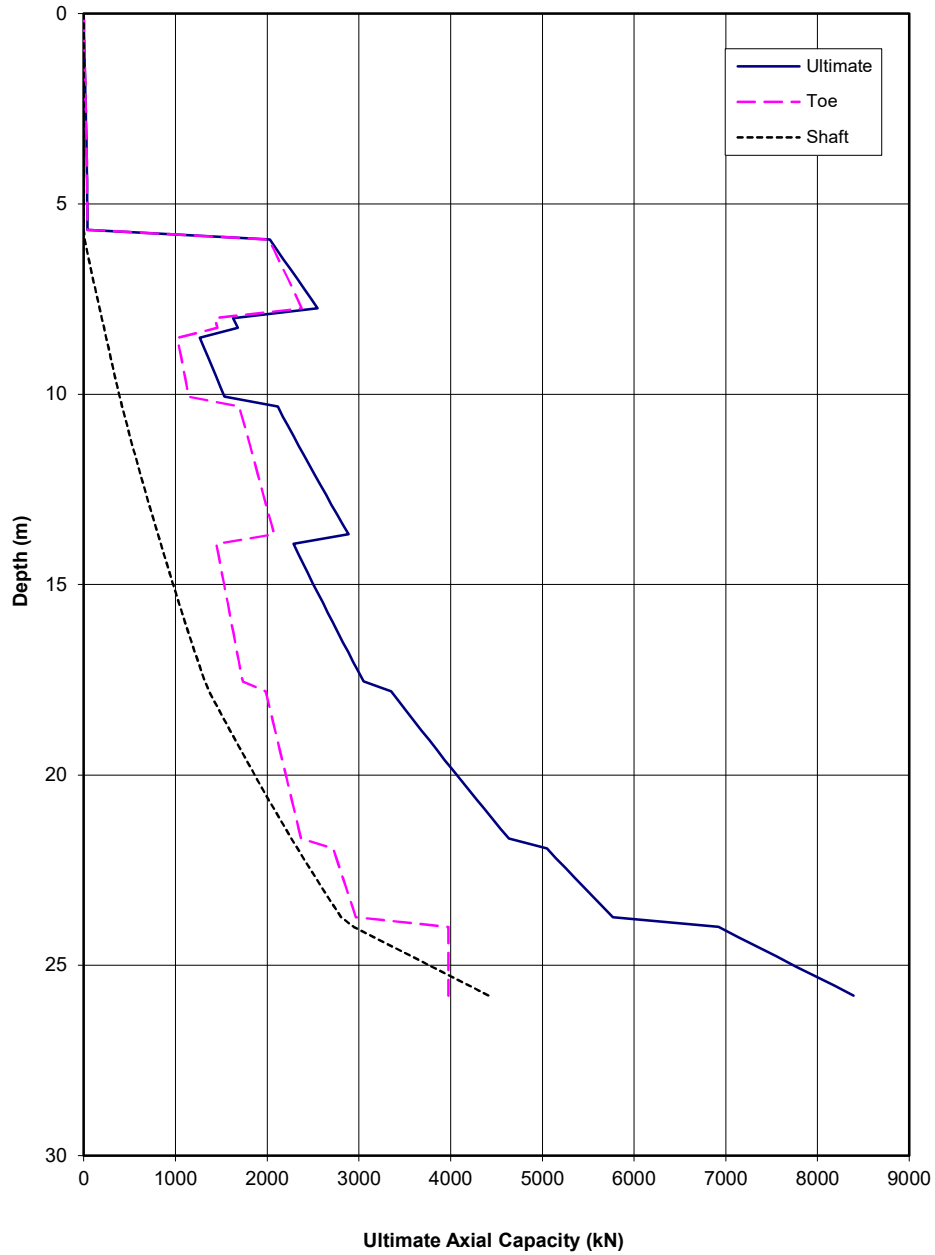
REPORT No.:  
60657467

DATE:-  
02-Nov-21

$N_q^*$  Values



circular concrete 0.75 m pile



PROJECT TITLE:-  
**Net Zero Teesside**



FIGURE TITLE:-  
**Preliminary Onshore Ground  
MSBH08 - Cooling**  
750mm dia. concrete Bored piles 2m rock  
CALCULATION OF AXIAL PILE CAPACITY USING THE BETA METHOD  
Ultimate Axial Pile Capacity

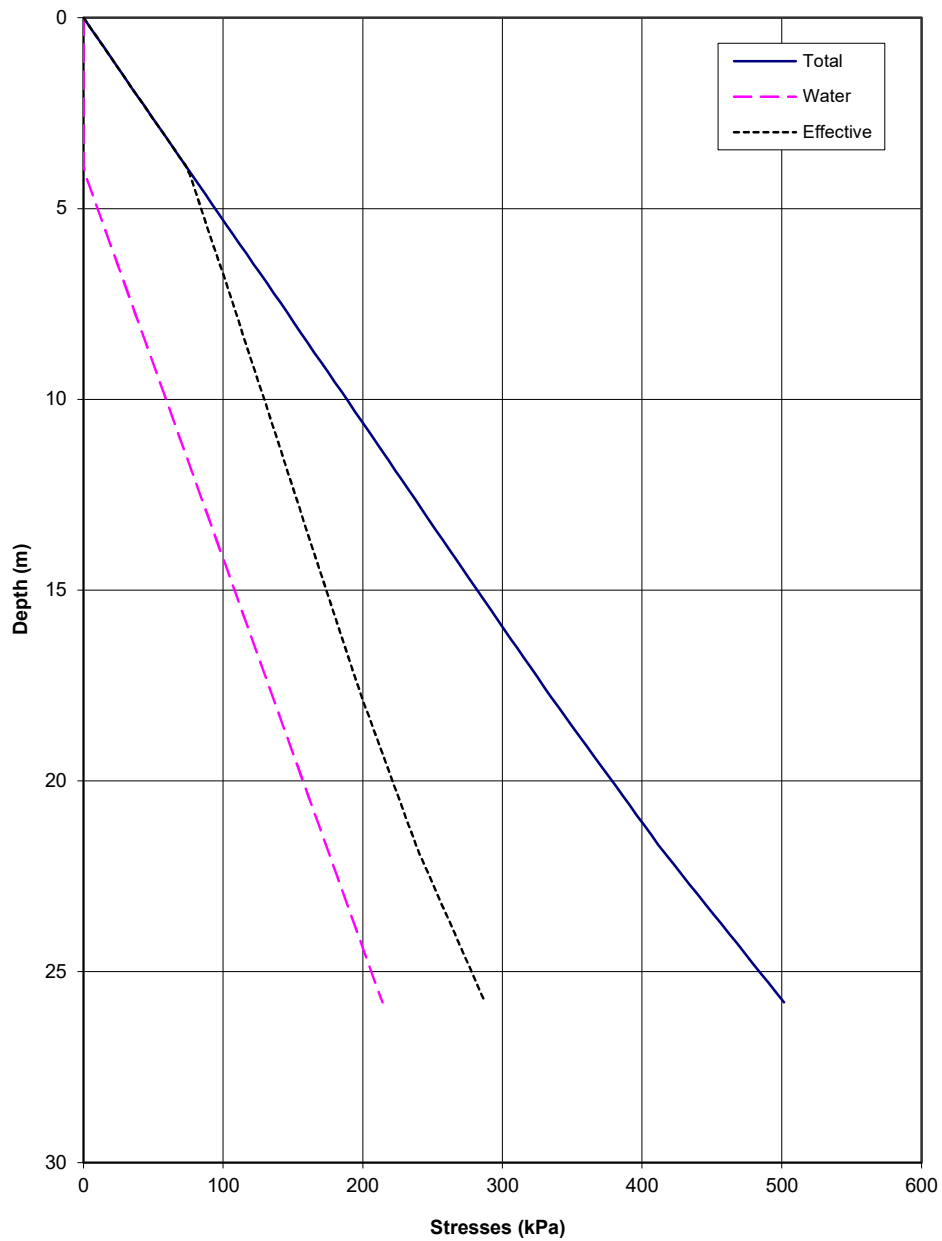
FIGURE No.:  
Figure 8

REPORT No:-  
60657467

DATE:-  
02-Nov-21



circular concrete 0.9 m pile



PROJECT TITLE:-  
Net Zero Teesside



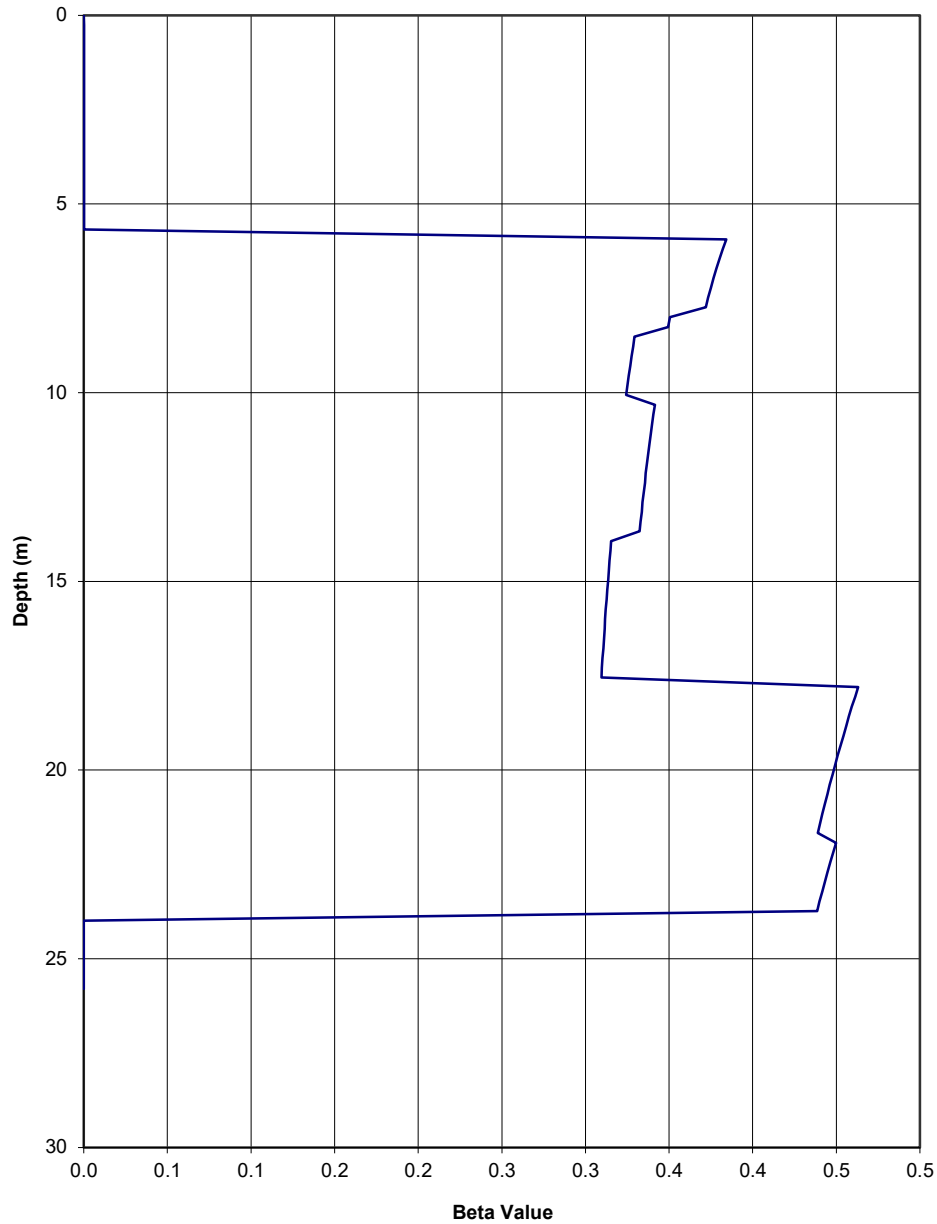
FIGURE TITLE:-  
**Preliminary Onshore Ground  
MS\BH08 - Cooling**  
900mm dia. concrete Bored piles 2m rock  
CALCULATION OF AXIAL PILE CAPACITY USING THE BETA METHOD  
  
Vertical Stress Profiles

FIGURE No.  
Figure 1

REPORT No.:  
60657467

DATE:-  
02-Nov-21

**circular concrete 0.9 m pile**



PROJECT TITLE:-  
**Net Zero Teesside**



FIGURE TITLE:-  
**Preliminary Onshore Ground Investigation  
MSIBH08 - Cooling**

900mm dia. concrete Bored piles 2m rock

CALCULATION OF AXIAL PILE CAPACITY USING THE BETA METHOD

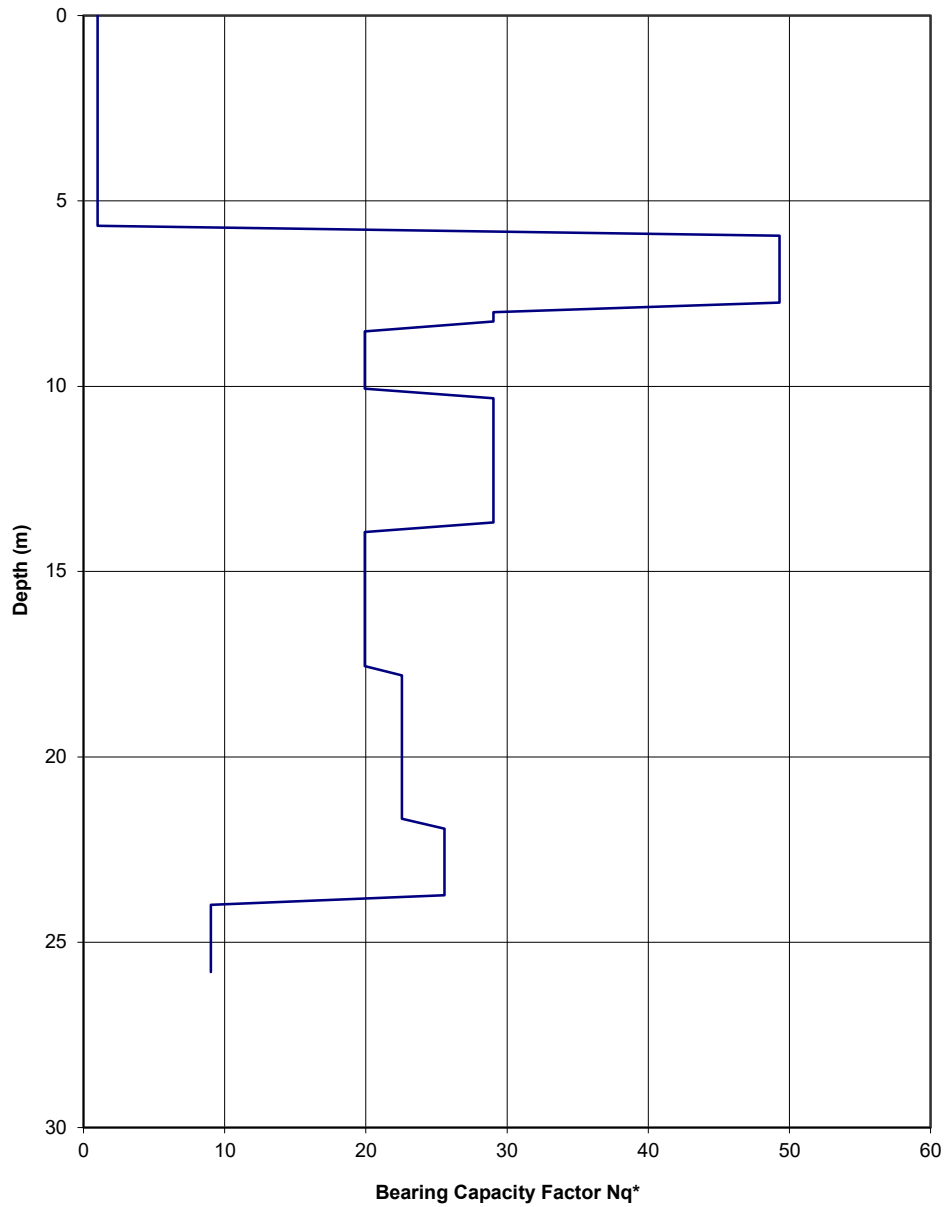
Beta Values

FIGURE No.:  
Figure 2

REPORT No.:  
60657467

DATE:-  
02-Nov-21

**circular concrete 0.9 m pile**



PROJECT TITLE:-  
**Net Zero Teesside**



FIGURE TITLE:-  
**Preliminary Onshore Ground Investigation**  
**MS\BH08 - Cooling**  
900mm dia. concrete Bored piles 2m rock  
CALCULATION OF AXIAL PILE CAPACITY USING THE BETA METHOD

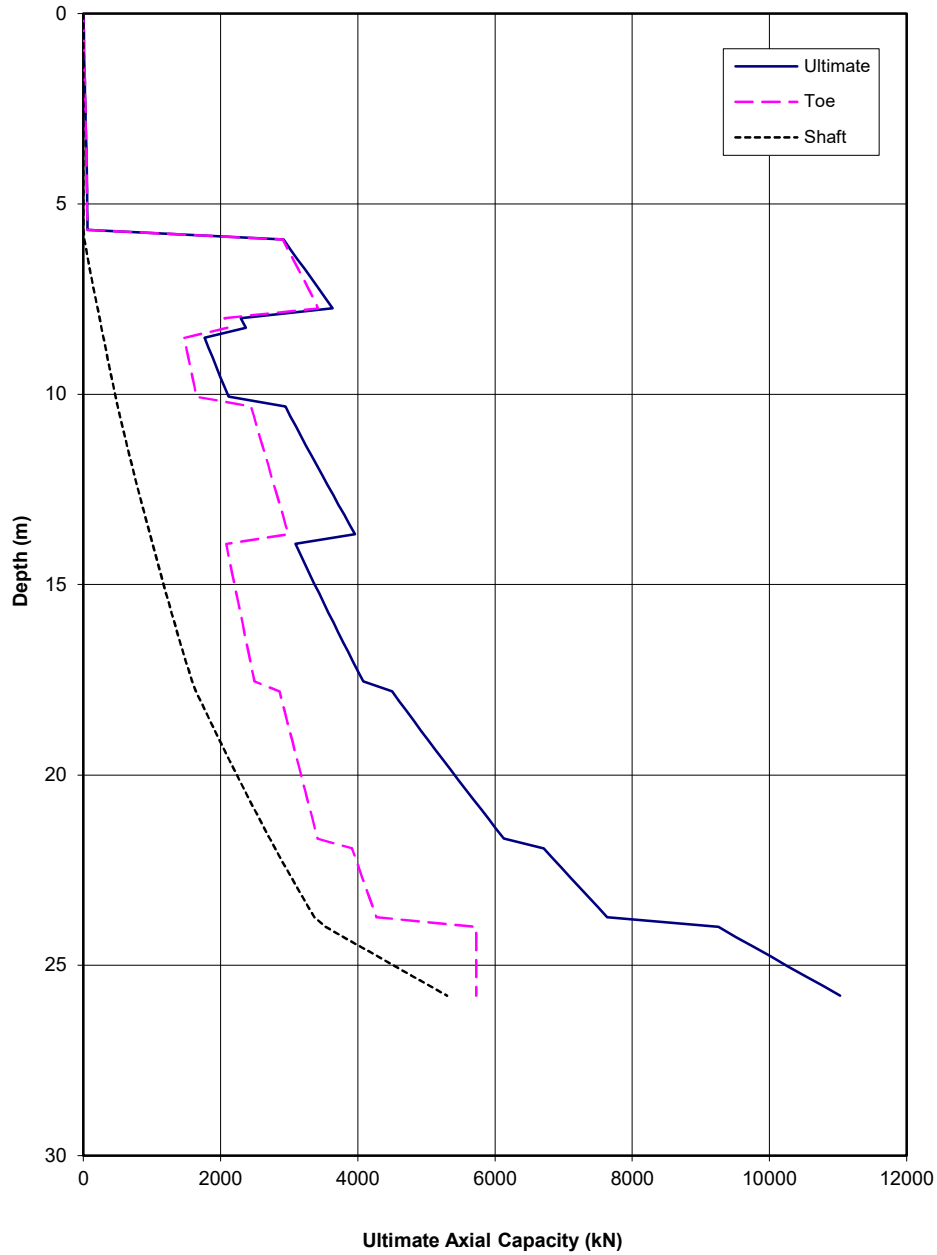
FIGURE No.:  
Figure 4

REPORT No.:  
60657467

DATE:-  
02-Nov-21

N<sub>q</sub>\* Values

circular concrete 0.9 m pile



PROJECT TITLE:-  
**Net Zero Teesside**



FIGURE TITLE:-  
**Preliminary Onshore Ground  
MSBH08 - Cooling**  
900mm dia. concrete Bored piles 2m rock  
CALCULATION OF AXIAL PILE CAPACITY USING THE BETA METHOD  
  
Ultimate Axial Pile Capacity

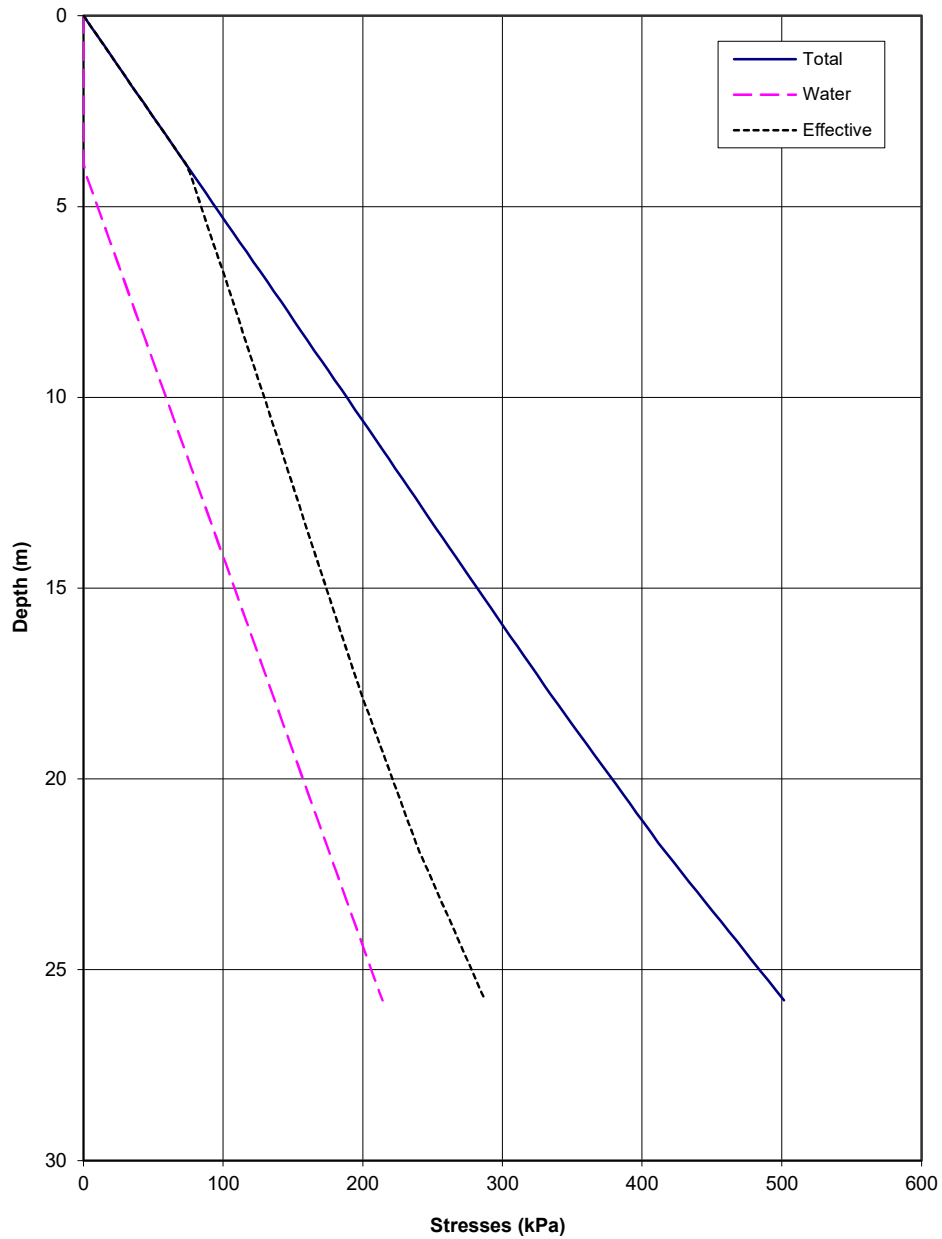
FIGURE No.:  
Figure 8

REPORT No:-  
60657467

DATE:-  
02-Nov-21



circular concrete 1.2 m pile



PROJECT TITLE:-  
**Net Zero Teesside**



FIGURE TITLE:-  
**Preliminary Onshore Ground  
MS\BH08 - Cooling**  
1200mm dia. concrete Bored piles 2m rock  
CALCULATION OF AXIAL PILE CAPACITY USING THE BETA METHOD  
  
Vertical Stress Profiles

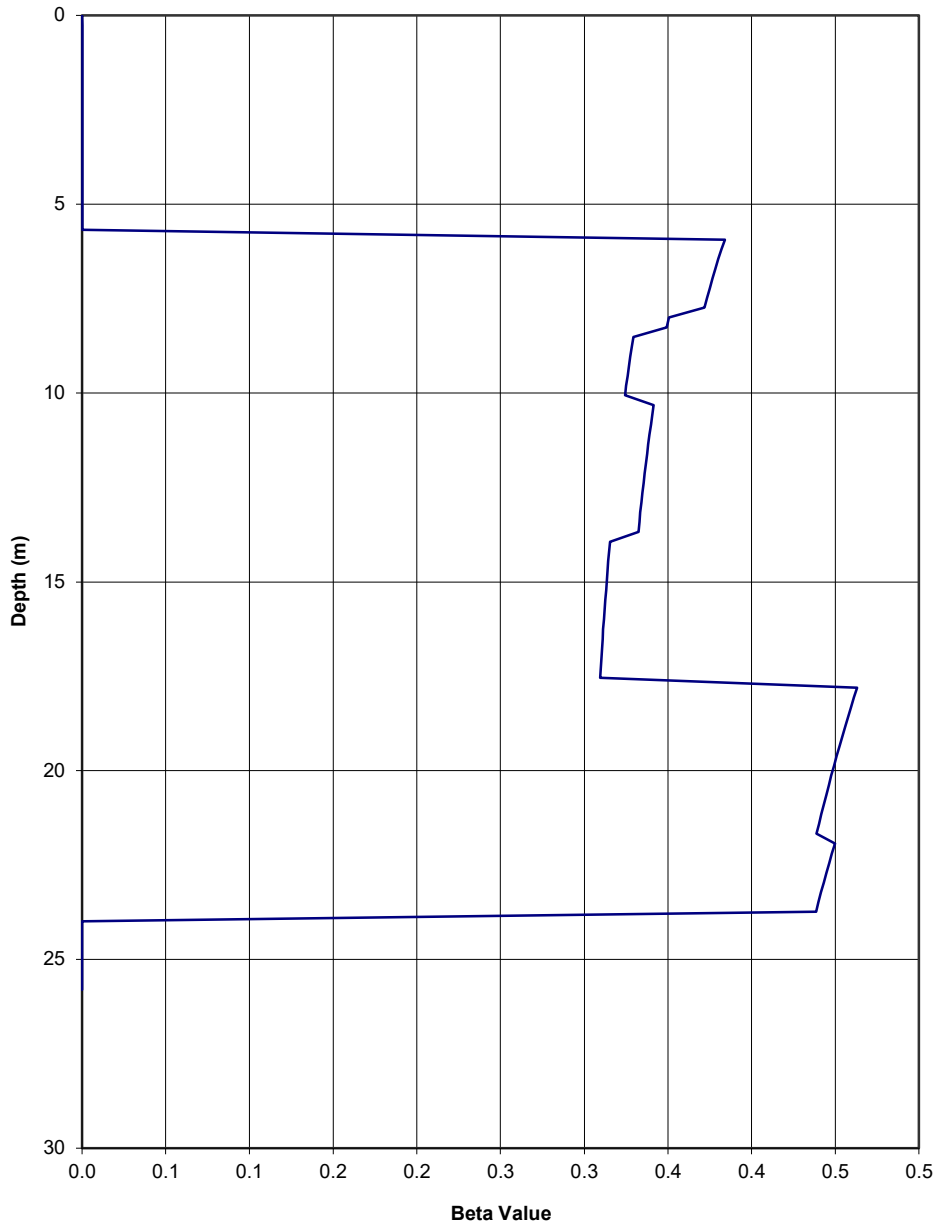
FIGURE No.  
Figure 1

REPORT No.:  
60657467

DATE:-  
02-Nov-21



circular concrete 1.2 m pile



PROJECT TITLE:-  
**Net Zero Teesside**



FIGURE TITLE:-  
**Preliminary Onshore Ground Investigation  
MSIBH08 - Cooling**

1200mm dia. concrete Bored piles 2m rock

CALCULATION OF AXIAL PILE CAPACITY USING THE BETA METHOD

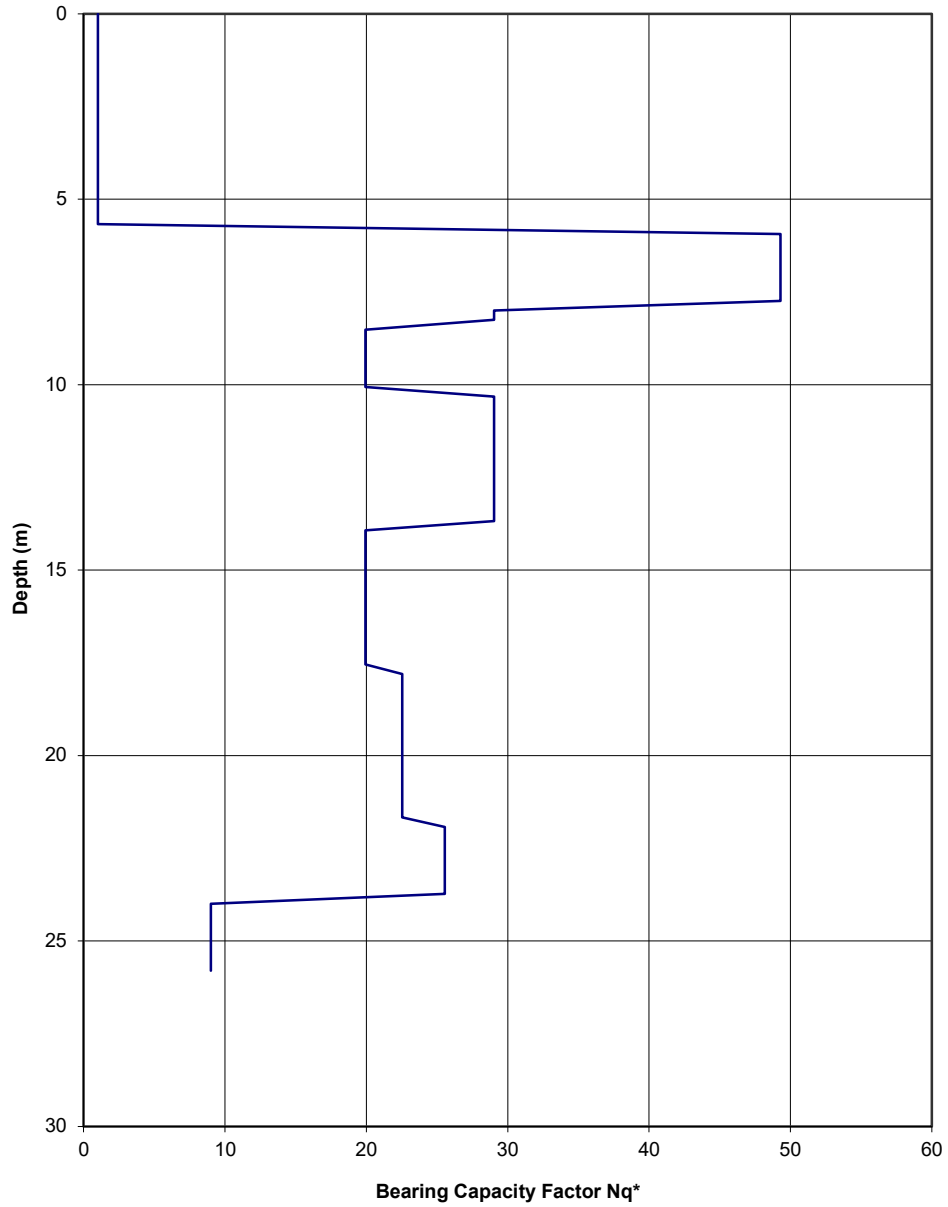
Beta Values

FIGURE No.:  
Figure 2

REPORT No.:  
60657467

DATE:-  
02-Nov-21

**circular concrete 1.2 m pile**



PROJECT TITLE:-  
**Net Zero Teesside**



FIGURE TITLE:-  
**Preliminary Onshore Ground Investigation**

FIGURE No.:  
Figure 4

**MS\BH08 - Cooling**

1200mm dia. concrete Bored piles 2m rock

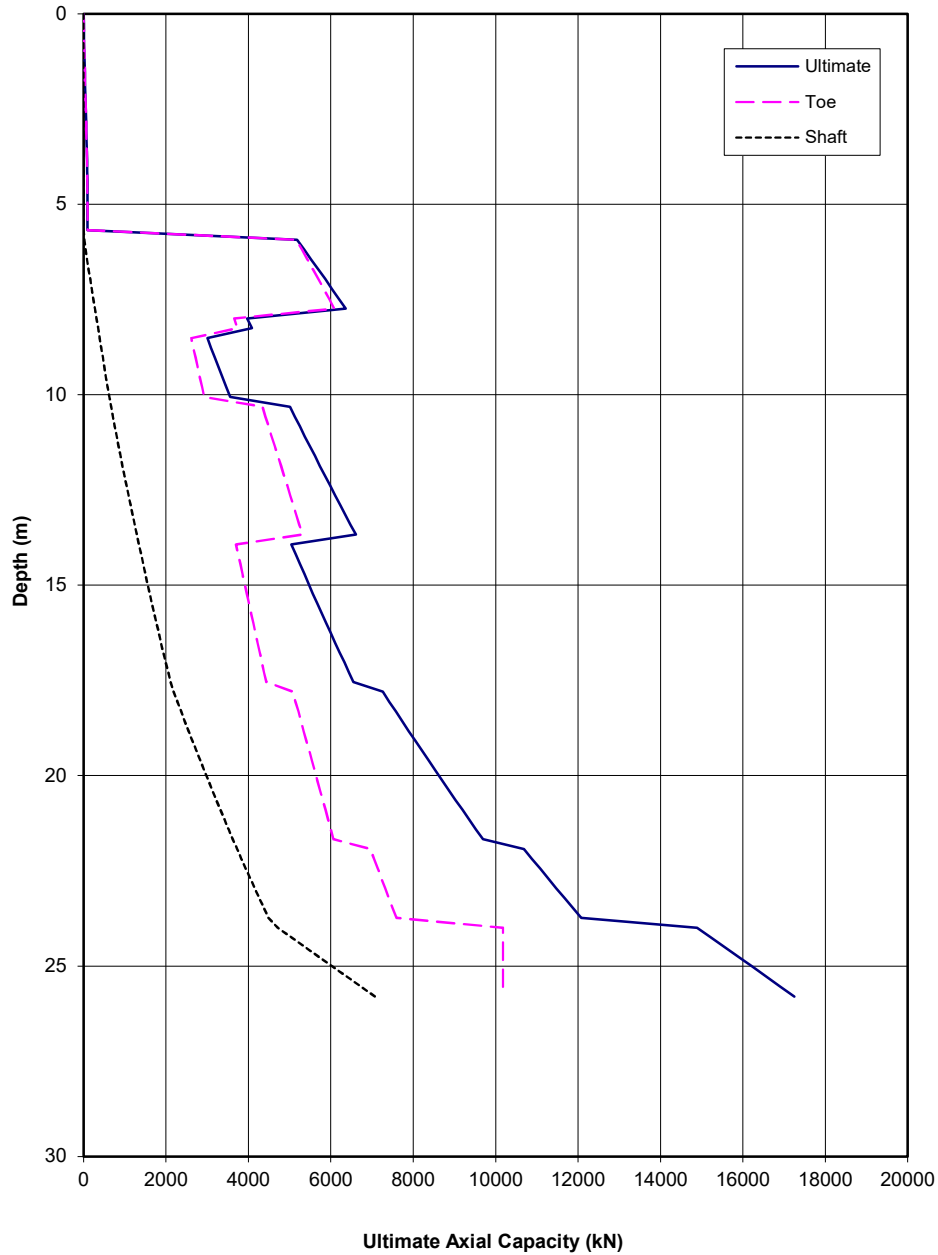
REPORT No.:  
60657467

CALCULATION OF AXIAL PILE CAPACITY USING THE BETA METHOD

$N_q^*$  Values

DATE:-  
02-Nov-21

circular concrete 1.2 m pile



PROJECT TITLE:-  
**Net Zero Teesside**



FIGURE TITLE:-  
**Preliminary Onshore Ground  
MSBH08 - Cooling**  
1200mm dia. concrete Bored piles 2m rock  
CALCULATION OF AXIAL PILE CAPACITY USING THE BETA METHOD  
Ultimate Axial Pile Capacity

FIGURE No.:  
Figure 8

REPORT No:-  
60657467

DATE:-  
02-Nov-21

CALCULATION OF AXIAL PILE CAPACITY USING THE BETA METHOD

FILE :	60657467	Summary	circular steel 0.34 m pile	FoS	Safe	Applied	kN
CLIENT :	bp on behalf of OGCI			2.50	801.30	800.00	800.00
JOB :	Net Zero Teesside	Skin	2003.26	3.00	272.38	200.00	200.00
SITE :	Preliminary Onshore Ground Investigation	Toe	817.13		1073.68		1000.00
LOCATION :	MSBH08 - Cooling	Total	2820.39				
SUBTITLE :	340mm dia. Steel Tubular pile 2m rock socket	Top Stress	31.06	N/mm <sup>2</sup>			
ENGR :	CMC	Stress Ratio	0.07				
CHECK :	SJM /NJ	Head settlement	6.56	mm	Toe estimate	5.00	mm
DATE :	02-Nov-21	Spring stiffness	152391	N/m			
Version	1.125						
Date updated:	12/09/14						
Author :	sdm						



**INPUT INFORMATION**

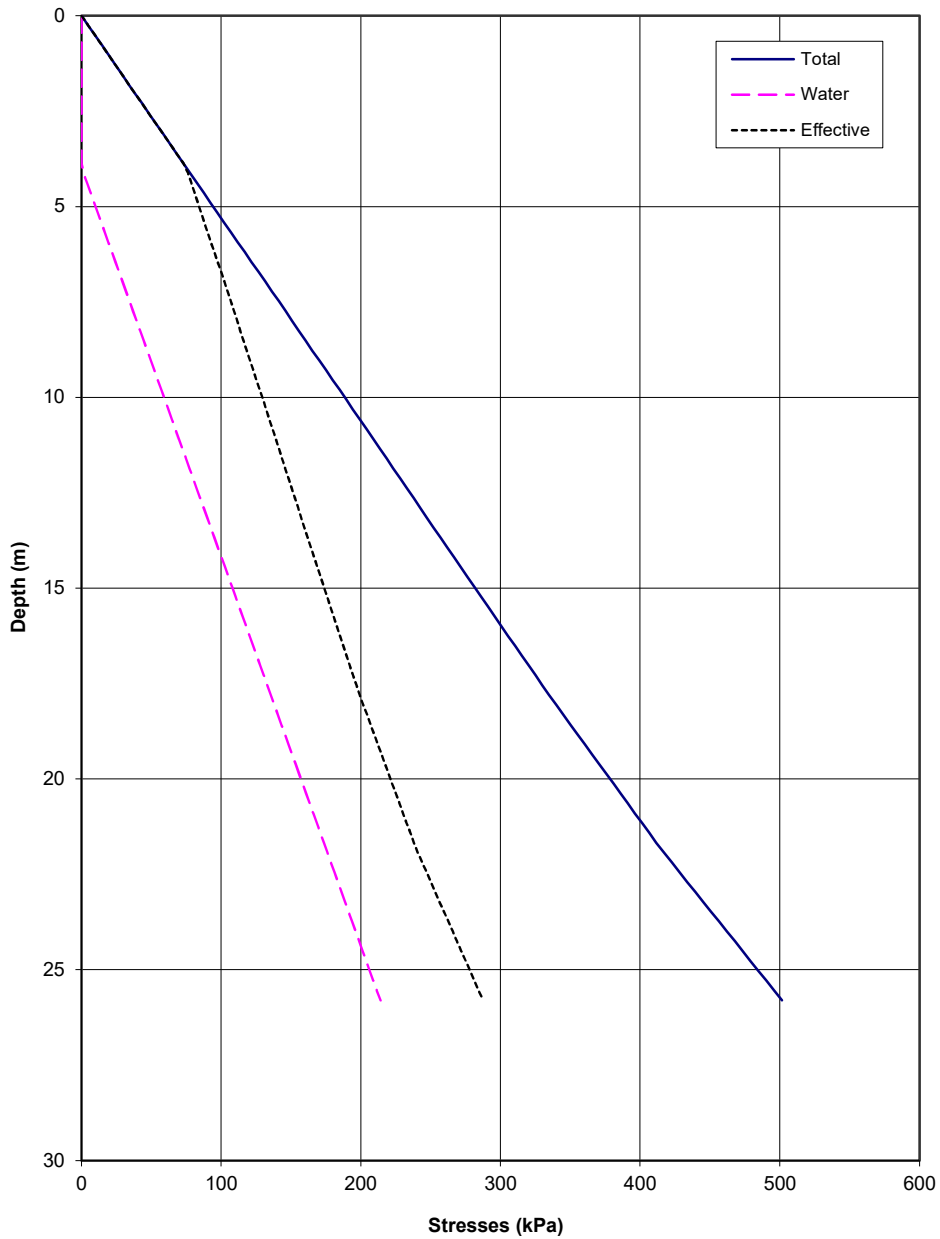
Existing ground level	7.98	mOD
Finished formation level	6.98	mOD
Pile cut off level	6.98	mOD
Embedment below cut off	25.80	m
Pile Top Level	-18.82	mOD
Depth below finished ground	25.80	m
Pile Type:	circular	
Installation Method:	driven	
Depth Water:	3.98	m
Unit Weight Water:	9.81	kN/m <sup>3</sup>
Pile Diameter:	0.340	m
:	0.000	m
:	0.002	m
Pile Base Area:	0.0908	sq.m
Shaft perimeter area	1.06814	sq.m/m
Surcharge:	0.00	kPa
Volume pile material	2.3424	m <sup>3</sup>
Compressive Strength:	420.00	N/mm <sup>2</sup>
Pile Modulus	2.1000E+08	(kPa)
Material:	steel	
Pile material section area	0.08079	sq.m

Soil Properties

Layer Number	Pile Depth (m)	Bulk Density (Mg/m3)	Friction Angle (deg)	Cohesion (kPa)	Interface Factor	Preload Stress (kPa)	Artesian Gradient	Material Type	Description
1	1.920	0.01	0.00	0.00	1.00	50.00		soil	d1 Made Ground - Slag dominant
2	5.90	1.950	34.00	0.00	1.00	50.00		soil	d2 Made Ground - Silty Sand
3	7.20	1.900	34.00	0.00	1.00	50.00		soil	d3 Made Ground - Gravel
4	7.80	1.900	30.00	0.00	1.00	50.00		soil	c2 Tidal Flats - Sand
5	8.50	1.920	27.00	0.00	1.00	50.00		soil	c1 Tidal Flats - Clay (soft organic)
6	10.20	1.900	30.00	0.00	1.00	50.00		soil	c2 Tidal Flats - Sand
7	13.80	2.000	27.00	0.00	1.00	50.00		soil	c1 Tidal Flats - Clay
8	17.80	2.020	28.00	0.00	1.00	50.00		soil	b3 Lacustrine Deposits - Laminated Clay
9	21.80	2.230	29.00	0.00	1.00	350.00		soil	b1 Glacial Till
10	23.80	2.230	0.00	1500.00	1.00	600.00		rock	a3 Redcar Mudstone Formation

Depth below (m)	Soil/Rock	Bulk Density (Mg/m3)	Total Stress (kPa)	Artesian Gradient	Water Stress (kPa)	Effective Stress (kPa)	Cohesion (kPa)	Friction Angle (degrees)	Interface Factor	Preload Stress (kPa)	OCR value	K n/c	K p	Triaxial Compr Strength (MPa)	Uniaxial Compr Strength (MPa)	Ko OC K	Beta Factor	Ucs alpha	Ucs Factor	Ultimate Skin Friction (kPa)	Ultimate Shaft Capacity (kN)	Ultimate Toe Capacity (kN)	Ultimate Axial Capacity (kN)	Dead Load Drag (kN)	Ultimate Net Skin (kN)	Working Stress (N/mm <sup>2</sup> )	Maximum Allowable Stress (N/mm <sup>2</sup> )	Incr. Pile Compr. (mm)	Working Pile Compr (mm)		
0.00	soil	1.92	0.00	1.00	0.00	0.00	0.00	0.01	1.00	50.00	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	800.00	2820.39	800.00	8.81	210.00	0.0108	1.56
0.26	soil	1.92	4.86	1.00	0.00	4.86	0.00	0.01	1.00	50.00	11.29	1.00	1.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	4.86	0.44	0.44	800.00	2820.39	800.00	8.81	210.00	0.0108	1.55
0.52	soil	1.92	9.72	1.00	0.00	9.72	0.00	0.01	1.00	50.00	22.58	1.00	1.00	0.01	0.00	1.00	1.00	0.00	1.00	0.00	0.00	9.73	0.88	0.88	800.00	2820.39	800.00	8.81	210.00	0.0108	1.54
0.77	soil	1.92	14.58	1.00	0.00	14.58	0.00	0.01	1.00	50.00	33.87	1.00	1.00	0.01	0.00	1.00	1.00	0.00	1.00	0.00	0.00	14.59	1.33	1.33	800.00	2820.39	800.00	8.81	210.00	0.0108	1.53
1.03	soil	1.92	19.44	1.00	0.00	19.44	0.00	0.01	1.00	50.00	45.16	1.00	1.00	0.01	0.00	1.00	1.00	0.00	1.00	0.00	0.00	19.45	1.77	1.77	800.00	2820.39	800.00	8.81	210.00	0.0108	1.52
1.29	soil	1.92	24.30	1.00	0.00	24.30	0.00	0.01	1.00	50.00	56.45	1.00	1.00	0.02	0.00	1.00	1.00	0.00	1.00	0.00	0.00	24.32	2.21	2.21	800.00	2820.39	800.00	8.81	210.00	0.0108	1.51
1.55	soil	1.92	29.16	1.00	0.00	29.16	0.00	0.01	1.00	50.00	67.74	1.00	1.00	0.03	0.00	1.00	1.00	0.00	1.00	0.00	0.00	29.19	2.65	2.65	800.00	2820.39	800.00	8.81	210.00	0.0108	1.50
1.81	soil	1.92	34.02	1.00	0.00	34.02	0.00	0.01	1.00	50.00	79.03	1.00	1.00	0.04	0.00	1.00	1.00	0.00	1.00	0.00	0.00	34.05	3.09	3.10	800.01	2820.38	800.01	8.81	210.00	0.0108	1.49
2.06	soil	1.92	38.88	1.00	0.00	38.88	0.00	0.01	1.00	50.00	90.32	1.00	1.00	0.05	0.00	1.00	1.00	0.00	1.00	0.00	0.00	38.92	3.53	3.54	800.01	2820.38	800.01	8.81	210.00	0.0108	1.48
2.32	soil	1.92	43.74	1.00	0.00	43.74	0.00	0.01	1.00	50.00	101.61	1.00	1.00	0.06	0.00	1.00	1.00	0.00	1.00	0.00	0.00	43.78	3.98	3.98	800.01	2820.38	800.01	8.81	210.00	0.0108	1.46
2.58	soil	1.92	48.59	1.00	0.00	48.59	0.00	0.01	1.00	50.00	112.90	1.00	1.00	0.07	0.00	1.00	1.00	0.00	1.00	0.00	0.00	48.65	4.42	4.43	800.01	2820.38	800.01	8.81	210.00	0.0108	1.45
2.84	soil	1.92	53.45	1.00	0.00	53.45	0.00	0.01	1.00	50.00	124.19	1.00	1.00	0.08	0.00	1.00	1.00	0.00	1.00	0.00	0.00	53.51	4.86	4.87	800.01	2820.38	800.01	8.81	210.00	0.0108	1.44
3.10	soil	1.92	58.31	1.00	0.00	58.31	0.00	0.01	1.00	50.00	135.48	1.00	1.00	0.09	0.00	1.00	1.00	0.00	1.00	0.00	0.00	58.36	5.30	5.32	800.02	2820.37	800.02	8.81	210.00	0.0108	1.43
3.35	soil	1.92	63.17	1.00	0.00	63.17	0.00	0.01	1.00	50.00	146.77	1.00	1.00	0.10	0.00	1.00	1.00	0.00	1.00	0.00	0.00	63.24	5.74	5.76	800.02	2820.37	800.02	8.81	210.00	0.0108	1.42
3.61	soil	1.92	68.03	1.00	0.00	68.03	0.00	0.01	1.00	50.00	158.06	1.00	1.00	0.11	0.00	1.00	1.00	0.00	1.00	0.00	0.00	68.11	6.18	6.21	800.02	2820.37	800.02	8.81	210.00	0.0108	1.41
3.87	soil	1.92	72.89	1.00	0.00	72.89	0.00	0.01	1.00	50.00	169.35	1.00	1.00	0.12	0.00	1.00	1.00	0.00	1.00	0.00	0.00	72.97	6.61	6.63	800.03	2820.36	800.03	8.81	210.00	0.0108	1.40
4.13	soil	1.92	77.75	1.00	0.00	77.75	0.00	0.01	1.00	50.00	180.64	1.00	1.00	0.13	0.00	1.00	1.00	0.00	1.00	0.00	0.00	77.83	7.05	7.07	800.03	2820.36	800.03	8.81	210.00	0.0108	1.39
4.39	soil	1.92	82.61	1.00	0.00	82.61	0.00	0.01	1.00	50.00	191.93	1.00	1.00	0.14	0.00	1.00	1.00	0.00	1.00	0.00	0.00	82.71	7.49	7.51	800.03	2820.36	800.03	8.81	210.00	0.0108	1.38
4.64	soil	1.92	87.47	1.00	0.00	87.47	0.00	0.01	1.00	50.00	203.22	1.00	1.00	0.15	0.00	1.00	1.00	0.00	1.00	0.00	0.00	87.54	7.93	7.95	800.04	2820.35	800.04	8.81	210.00	0.0108	1.37
4.90	soil	1.92	92.33	1.00	0.00	92.33	0.00	0.01	1.00	50.00	214.51	1.00	1.00	0.16	0.00	1.00	1.00	0.00	1.00	0.00	0.00	92.37	8.37	8.39	800.04	2820.35	800.04	8.81	210.00	0.0108	1.36
5.16	soil	1.92	97.19	1.00	0.00	97.19	0.00	0.01	1.00	50.00	225.80	1.00	1.00	0.17	0.00	1.00	1.00	0.00	1.00	0.00	0.00	97.25	8.81	8.83	800.05	2820.34	800.05	8.81	210.00	0.0108	1.35
5.42	soil	1.92	102.05	1.00	0.00	102.05	0.00	0.01	1.00	50.00	237.09	1.00	1.00	0.18	0.00	1.00	1.00	0.00	1.00	0.00	0.00	102.15	9.25	9.27	800.05	2820.34	800.05	8.81	210.00	0.0108	1.33
5.68	soil	1.92	106.91	1.00	0.00	106.91	0.00	0.01	1.00	50.00	248.38	1.00	1.00	0.19	0.00	1.00	1.00	0.00	1.00	0.00	0.00	107.05	9.70	9.72	800.05	2820.34	800.05	8.81	210.00	0.0108	1.32
5.93	soil	1.92	111.77	1.00	0.00	111.77	0.00	0.01	1.00	50.00	259.67	1.00	1.00	0.20	0.00	1.00	1.00	0.00	1.00	0.00	0.00	111.87	10.15	10.17	800.06	2820.33	800.06	8.81	210.00	0.0108	1.31
6.19	soil	1.95	116.74	1.00	0.00	116.74	0.00	0.01	1.00	50.00	270.96	1.00	1.00	0.21	0.00	1.00	1.00	0.00	1.00	0.00	0.00	116.96	10.60	10.62	800.06	2820.33	800.06	8.81	210.00	0.0110	1.30
6.45	soil	1.95	121.68	1.00	0.00	121.68	0.00	0.01	1.00	50.00	282.25	1.00	1.00	0.22	0.00	1.00	1.00	0.00	1.00	0.00	0.00	122.18	11.05	11.07	800.07	2820.32	800.07	8.81	210.00	0.0111	1.29
6.71	soil	1.95	126.61	1.00	0.00	126.61	0.00	0.01	1.00	50.00	293.54	1.00	1.00	0.23	0.00	1.00	1.00	0.00	1.00	0.00	0.00	127.11	11.50	11.52	800.07	2820.32	800.07	8.81	210.00	0.0112	1.28
6.97	soil	1.95	131.55	1.00	0.00	131.55	0.00	0.01	1.00	50.00	304.83	1.00	1.00	0.24	0.00	1.00	1.00	0.00	1.00	0.00	0.00	132.04	11.95	11.97	800.08	2820.31	800.08	8.81	210.00	0.0114	1.27
7.23	soil	1.90	136.42	1.00	0.00	136.42	0.00	0.01	1.00	50.00	316.12	1.00	1.00	0.25	0.00	1.00	1.00	0.00	1.00	0.00	0.00	136.96	12.40	12.42	800.08	2820.31	800.08	8.81	210.00	0.0115	1.26
7.48	soil	1.90	141.23	1.00	0.00	141.23	0.00	0.01	1.00	50.00	327.41	1.00	1.00	0.26	0.00	1.00	1.00	0													

circular steel 0.34 m pile



PROJECT TITLE:-  
**Net Zero Teesside**



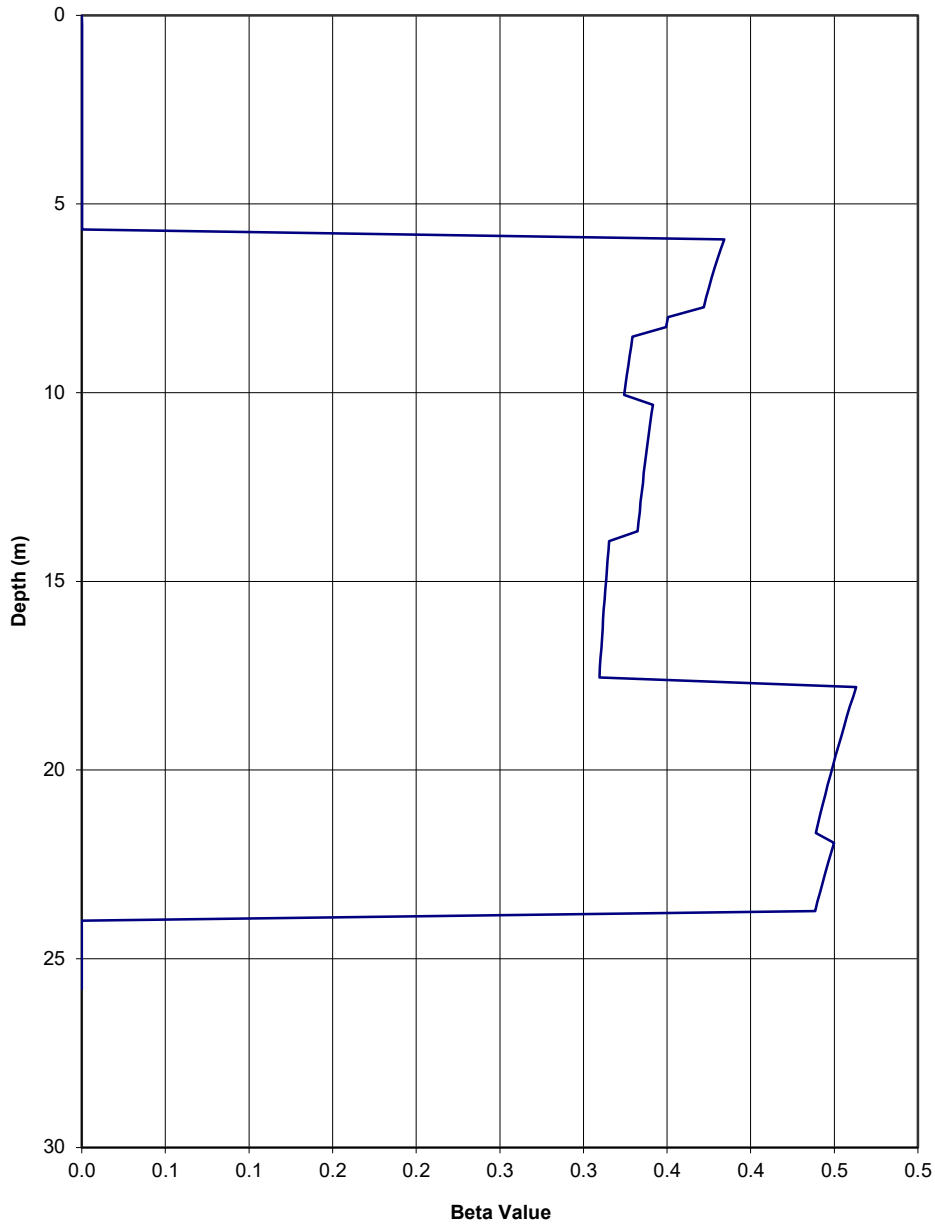
FIGURE TITLE:-  
**Preliminary Onshore Ground  
MS\BH08 - Cooling**  
340mm dia. Steel Tubular pile 2m rock  
CALCULATION OF AXIAL PILE CAPACITY USING THE BETA METHOD  
  
Vertical Stress Profiles

FIGURE No.  
Figure 1

REPORT No.:  
60657467

DATE:-  
02-Nov-21

circular steel 0.34 m pile



PROJECT TITLE:-

**Net Zero Teesside**



FIGURE TITLE:-

**Preliminary Onshore Ground Investigation  
MSIBH08 - Cooling**

340mm dia. Steel Tubular pile 2m rock

CALCULATION OF AXIAL PILE CAPACITY USING THE BETA METHOD

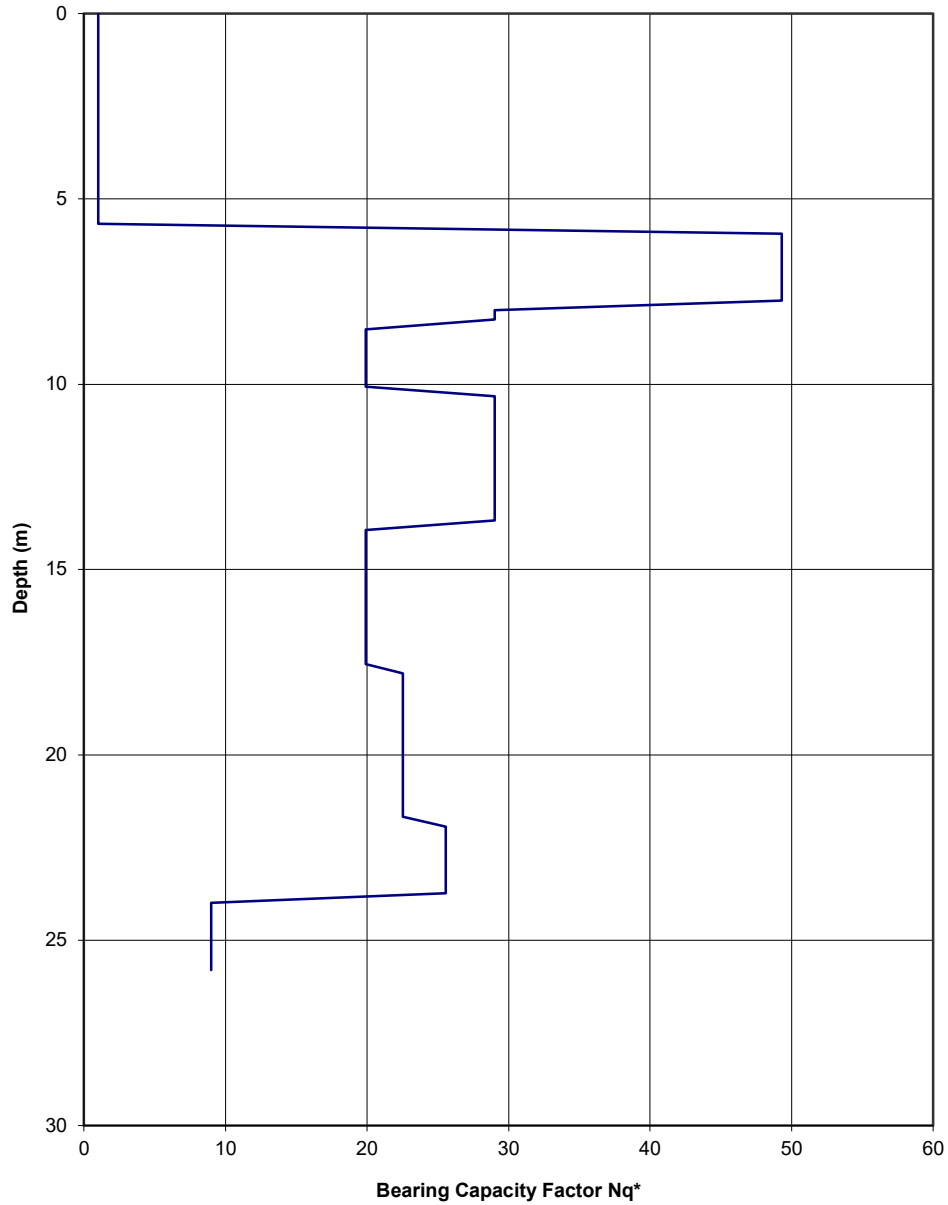
Beta Values

FIGURE No.:  
Figure 2

REPORT No.:  
60657467

DATE:-  
02-Nov-21

**circular steel 0.34 m pile**



PROJECT TITLE:-  
**Net Zero Teesside**



FIGURE TITLE:-  
**Preliminary Onshore Ground Investigation**

FIGURE No.:  
Figure 4

**MS\BH08 - Cooling**

340mm dia. Steel Tubular pile 2m rock

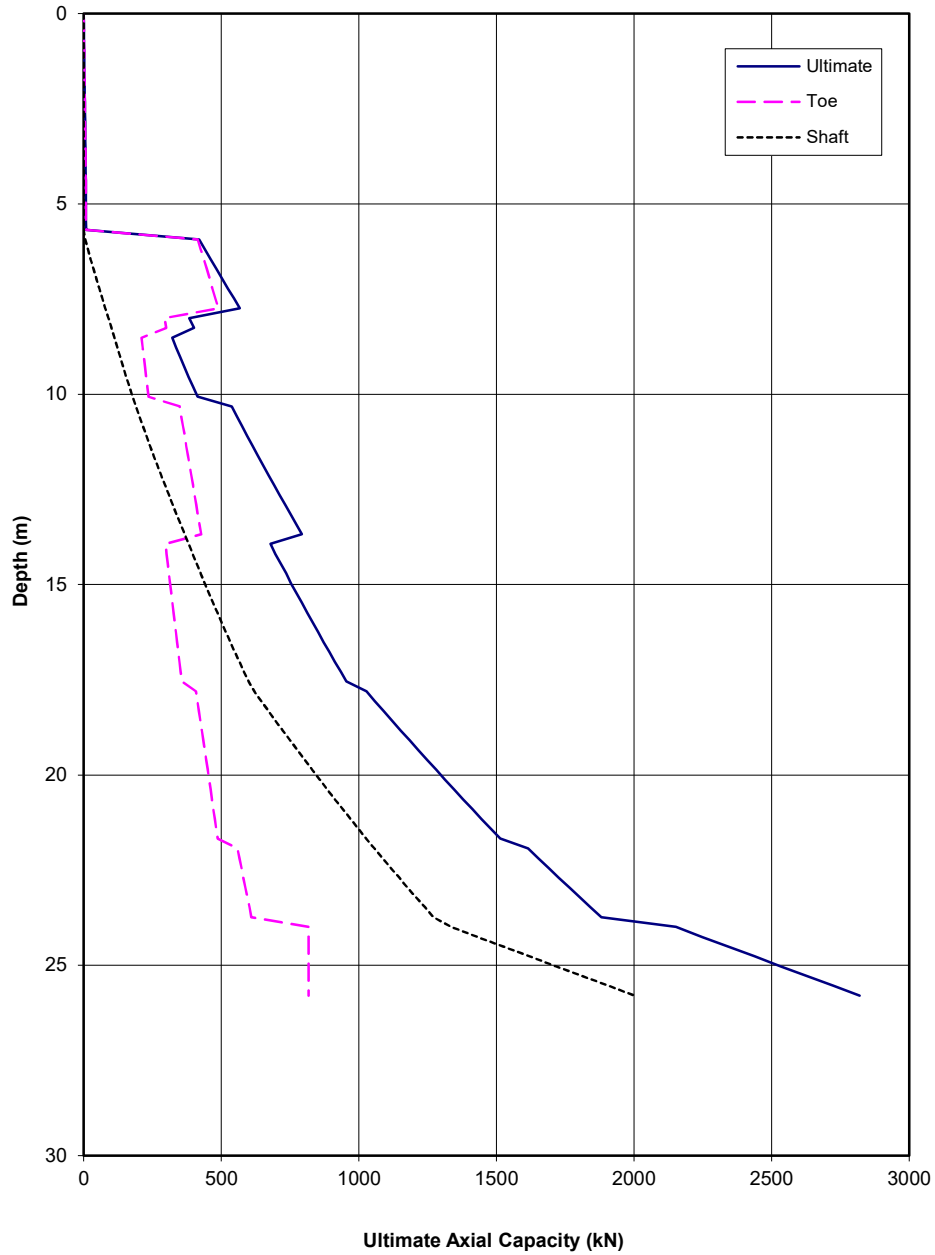
REPORT No.:  
60657467

CALCULATION OF AXIAL PILE CAPACITY USING THE BETA METHOD

$N_q^*$  Values

DATE:-  
02-Nov-21

circular steel 0.34 m pile



PROJECT TITLE:-  
**Net Zero Teesside**



FIGURE TITLE:-  
**Preliminary Onshore Ground  
MSBH08 - Cooling**  
340mm dia. Steel Tubular pile 2m rock  
CALCULATION OF AXIAL PILE CAPACITY USING THE BETA METHOD  
Ultimate Axial Pile Capacity

FIGURE No.:  
Figure 8

REPORT No:-  
60657467

DATE:-  
02-Nov-21