

Technologies to manage risk for infrastructure

Boston Atlanta Chicago Los Angeles New York www.geotesting.com

Transm	nittal			
TO:				
Delaney Pete	erson		DATE: 1/19/2021	GTX NO: 312780
Anchor QEA, LLC			RE: GascoSiltronic: US Mo	orings 11242020
720 Olive Way, Suite 1900				
Seattle, WA	98101			
COPIES	DATE		DESCRIPTION	
	1/19/2021	January 2021 Laboratory Test	Report	
EMARKS:				
		SIGNED:	Bulsh	
			Barbara Sanchez, Assistant	Laboratory Manager
		APPROVED BY:	Jon Tu	m

Jonathan Campbell, Laboratory Manager



Technologies to manage risk for infrastructure

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January 19, 2021

Delaney Peterson Anchor QEA, LLC 720 Olive Way, Suite 1900 Seattle, WA 98101

RE: GascoSiltronic: US Moorings 11242020, (GTX-312780)

Dear Delaney Peterson:

Enclosed are the test results you requested for the above referenced project. GeoTesting Express, Inc. (GTX) received one sample from you on 11/24/2020. This sample was labeled as follows:

Boring Number Sample Number USMPDI- 013SG-201116

GTX performed the following tests on this sample:

ASTM D2216 - Moisture Content
ASTM D4318 - Atterberg Limits
ASTM D6913/D7928 - Grain Size Analysis - Sieve and Hydrometer
ASTM D854 - Specific Gravity

A copy of your test request is attached.

The results presented in this report apply only to the items tested. This report shall not be reproduced except in full, without written approval from GeoTesting Express. The remainder of these samples will be retained for a period of sixty (60) days and will then be discarded unless otherwise notified by you. Please call me if you have any questions or require additional information. Thank you for allowing GeoTesting Express the opportunity of providing you with testing services. We look forward to working with you again in the future.

Respectfully yours,

Barbara Sanchez

Assistant Laboratory Manager

GeoTesting Express, Inc. 125 Nagog Park Acton, MA 01720 Toll Free 800 434 1062 Fax 978 635 0266



Technologies to manage risk for infrastructure

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Geotechnical Test Report

1/19/2021

GTX-312780

GascoSiltronic: US Moorings

11242020

Prepared for:

Anchor QEA, LLC



Client: Anchor QEA, LLC

Project: GascoSiltronic: US Moorings 11242020

Location: Project No: GTX-312780 Boring ID: USMPDI-Sample Type: bag Tested By: ckg

Sample ID: 013SG-201116 01/06/21 Checked By: bfs Test Date:

Test Id: 595601 Depth: Test Comment:

Visual Description: Wet, dark olive brown silt

Sample Comment:

Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content,%
USMPDI-	013SG- 201116		Wet, dark olive brown silt	161.3

Notes: Temperature of Drying: 110° Celsius



Client: Anchor QEA, LLC

Project: GascoSiltronic: US Moorings 11242020

Location: Project No: GTX-312780

Boring ID: USMPDI- Sample Type: bag Tested By: ckg

595602

Boring ID: USMPDI- Sample Type: bag Tested By: ckg Sample ID: 013SG-201116 Test Date: 01/12/21 Checked By: bfs

Depth: --- Test Id:
Test Comment: ---

Visual Description: Wet, dark olive brown silt

Sample Comment: ---

Specific Gravity of Soils by ASTM D854

Boring ID	Sample ID	Depth	Visual Description	Specific Gravity
USMPDI-	013SG- 201116		Wet, dark olive brown silt	2.60

Notes: Specific Gravity performed by using method B (oven dried specimens) of ASTM D854 Moisture Content determined by ASTM D2216.



Client: Anchor QEA, LLC

Project: GascoSiltronic: US Moorings 11242020

Location: Project No: GTX-312780 Tested By: ckg

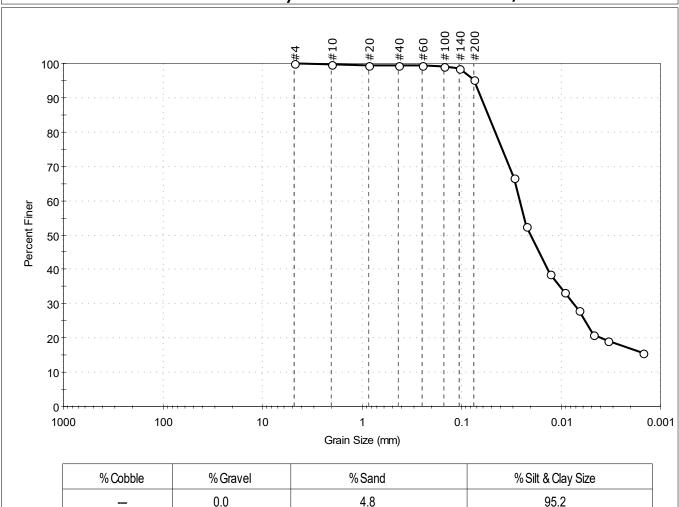
Boring ID: USMPDI-Sample Type: bag Sample ID: 013SG-201116 Test Date: 01/09/21 Checked By:

Test Id: 595600 Depth:

Test Comment: Visual Description: Wet, dark olive brown silt

Sample Comment:

Particle Size Analysis - ASTM D6913/D7928



Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	99		
#60	0.25	99		
#100	0.15	99		
#140	0.11	98		
#200	0.075	95		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
	0.0299	67		
	0.0221	53		
	0.0128	39		
	0.0091	33		
	0.0066	28		
	0.0047	21		
	0.0033	19		
	0.0015	16		

<u>Coeffic</u>	<u>cients</u>
D ₈₅ =0.0541 mm	$D_{30} = 0.0074 \text{ mm}$
D ₆₀ = 0.0259 mm	$D_{15} = N/A$
D ₅₀ = 0.0200 mm	$D_{10} = N/A$
Cu =N/A	$C_C = N/A$

<u>Classification</u> Elastic SILT (MH) <u>ASTM</u>

AASHTO Clayey Soils (A-7-5 (54))

<u>Sample/Test Description</u> Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness: ---

Dispersion Device: Apparatus A - Mech Mixer

Dispersion Period: 1 minute Est. Specific Gravity: 2.65 Separation of Sample: #200 Sieve



Client: Anchor QEA, LLC

Project: GascoSiltronic: US Moorings 11242020

Location: Project No: GTX-312780

Boring ID: USMPDI- Sample Type: bag Tested By: cam

Boring ID: USMPDI- Sample Type: bag Tested By: can Sample ID: 013SG-201116 Test Date: 01/14/21 Checked By: bfs

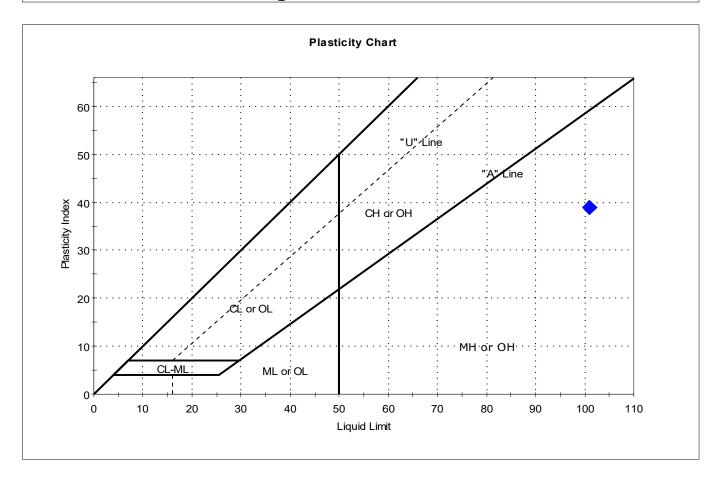
Depth: --- Test Id: 595599

Test Comment: ---

Visual Description: Wet, dark olive brown silt

Sample Comment: ---

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
•	013SG-201116	USMPDI-		161	101	62	39	2.5	Elastic SILT (MH)

Sample Prepared using the WET method

1% Retained on #40 Sieve Dry Strength: VERY HIGH

Dilatancy: SLOW Toughness: LOW



Date Printed: 11/17/2020

ENVIRONMENTAL SAMPLE CHAIN OF CUSTODY

COC ID:

GEO-20201117-162022

POC: * Delaney Peterson (360-715-2707)

Project:

GascoSiltronic: US Moorings

Sample Custodian:

SN

1605 Cornwall Avenue, Bellingham, WA 98225

Client:

NW Natural

Lab:

Geotesting Express

COC Sample Number	Field Sample ID	Sample Type	Matrix	Collect Date	ed Time	# Containers	Lab QC*	Test Request	Method	TAT**	Preservative
001	USMPDI-013SG-201116	N	SE	11/16/2020	12:15	1					
								Atterberg Limits	D4318	30	4°C
								Grain Size	D6913/D7928	30	4°C
								Moisture Content	D2216	30	4°C

+ specific gravity

Comment:					
1					
Relinquished By:	Received By:	Relinquished By:	Received By:	Relinquished By:	Received By:
Signature	Signature	Signature	Signature	Signature	Signature
Print Name Sasha Nana 1964	Print Name	Print Name	Print Name	Print Name	Print Name
Company Anchor OFA	Company	Company	Company	Company	Company
Date/Time	Date/Time	Date/Time	Date/Time	Date/Time	Date/Time



WARRANTY and LIABILITY

GeoTesting Express (GTX) warrants that all tests it performs are run in general accordance with the specified test procedures and accepted industry practice. GTX will correct or repeat any test that does not comply with this warranty. GTX has no specific knowledge as to conditioning, origin, sampling procedure or intended use of the material

GTX may report engineering parameters that require us to interpret the test data. Such parameters are determined using accepted engineering procedures. However, GTX does not warrant that these parameters accurately reflect the true engineering properties of the *in situ* material. Responsibility for interpretation and use of the test data and these parameters for engineering and/or construction purposes rests solely with the user and not with GTX or any of its employees.

GTX's liability will be limited to correcting or repeating a test which fails our warranty. GTX's liability for damages to the Purchaser of testing services for any cause whatsoever shall be limited to the amount GTX received for the testing services. GTX will not be liable for any damages, or for any lost benefits or other consequential damages resulting from the use of these test results, even if GTX has been advised of the possibility of such damages. GTX will not be responsible for any liability of the Purchaser to any third party.

Commonly Used Symbols

B pore pressure parameter for $\Delta \circ s$ T temperature $S \circ s$ CAI CERCHAR Abrasiveness index $S \circ s$ to time of the propersion ratio for one dimensional consolidation $S \circ s$ cyclic stress ratio $S $	A	pore pressure parameter for $\Delta \sigma_1 - \Delta \sigma_3$	$S_{\rm r}$	Post cyclic undrained shear strength
CAI Use CERCHAR Abrasiveness Index CIU is or compression ratio for one dimensional consolidation cross or compression ratio for one dimensional consolidation consequence of the compression ratio for one dimensional consolidation consequence of the compression ratio for one dimensional consolidation consequence of the compression ratio for one dimensional consolidation consequence of the co	В	pore pressure parameter for $\Delta\sigma_3$		·
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	CAI	CERCHAR Abrasiveness Index		1
CR CSR compression ratio for one dimensional consolidation UU, Q unconsolidated undrained triaxial test CSR cyclic stress ratio u. a excess pore water pressure C₂ coefficient of curvature, $(D x_0)^2 / (D r_0 x D r_0)$ u. u. w pore gas pressure C₂ coefficient of consolidation V total volume volume of solids C₂ coefficient of consolidation V₂ volume of solids c⟩ coefficient of consolidation V₂ volume of solids c⟩ coefficient of consolidation V₂ volume of solids c⟩ coefficient of consolidation V₂ volume of voids c⟩ cohesion intercept for tofal stresses V₂ volume of voids D diameter at which 10% of soil is finer V₂ volume of voids D diameter at which 10% of soil is finer V₂ volume of voids D ₀ diameter at which 30% of soil is finer W₂ veight of value D ₀ diameter at which 30% of soil is finer W₂ veight of value D ₀ diameter at which 85% of soil is finer	CIU	isotropically consolidated undrained triaxial shear test		
CSR cyclic stress ratio u_a pore gas pressure C_a coefficient of curvature, $(D \otimes)^2 / (D \log x D \otimes)$ u_a excess pore water pressure C_a coefficient of curvature, $(D \otimes)^2 / (D \log x D \otimes)$ u_b excess pore water pressure C_a coefficient of secondary compression V_a volume of gas c_b coefficient of secondary compression V_a volume of solids c_b coefficient of secondary compression V_a volume of solids c_b coefficient of consolidation V_a volume of solids c_b coefficient of consolidation V_a volume of solids c_b cobesion intercept for total stresses V_a volume of voids c_b dameter at which 10% of soil is finer V_a volume of voids c_b dameter at which 15% of soil is finer V_a volume of voids c_b diameter at which 15% of soil is finer V_a weight of solids c_b diameter at which 50% of soil is finer V_a V_a water content	CR	compression ratio for one dimensional consolidation	,	•
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	CSR	cyclic stress ratio		
Ga coefficient of uniformity, Don/D10 u, uw pore water pressure Ca compression index for one dimensional consolidation Vg volume of gas Ca coefficient of secondary compression Vg volume of gas Ca coefficient of consolidation Vg volume of solids C cohesion intercept for total stresses Vy volume of voids D diameter of specimen Vw volume of water D diameter at which 10% of soil is finer Vw volume of water Dis diameter at which 15% of soil is finer Ww weight of solids Ds0 diameter at which 30% of soil is finer Ww weight of solids Ds0 diameter at which 50% of soil is finer Ww water content Ds0 diameter at which 50% of soil is finer Ww water content Ds0 diameter at which 50% of soil is finer Ww water content Ds0 diameter at which 50% of soil is finer Ww water content Ds0 diameter at which 50% of soil is finer Ww water content	C_c	coefficient of curvature, $(D_{30})^2 / (D_{10} \times D_{60})$		
Cc compression index for one dimensional consolidation Vg total volume Cs coefficient of secondary compression Vg volume of gas c cobesion intercept for total stresses Vs shear wave velocity c cobesion intercept for effective stresses Vs volume of voids D diameter of specimen Vw volume of water D diameter at which 10% of soil is finer Vv volume of water Dis diameter at which 10% of soil is finer W total weight Dis diameter at which 30% of soil is finer W weight of soilds Ds diameter at which 50% of soil is finer W water content Ds diameter at which 60% of soil is finer W water content Ds diameter at which 85% of soil is finer W water content Ds diameter at which 85% of soil is finer W water content Ds diameter at which 85% of soil is finer W water content Ds diameter at which 85% of soil is finer W water content Ds	C_{u}	coefficient of uniformity, D ₆₀ /D ₁₀		<u> </u>
Ca coefficient of secondary compression Vg volume of solids c. coefficient of consolidation Vg volume of solids c. coefficient of consolidation Vg volume of voids d. coefficient of consolidation Vg volume of voids D. diameter of specimen Vg volume of water D. dameter at which 15% of soil is finer Vg volume of water D. diameter at which 15% of soil is finer Wg weight of solids D. diameter at which 50% of soil is finer Wg weight of water D. diameter at which 50% of soil is finer Wg water content D. diameter at which 50% of soil is finer Wg water content D. diameter at which 50% of soil is finer Wg water content D. diameter at which 50% of soil is finer Wg water content D. diameter at which 50% of soil is finer Wg water content D. diameter at which 50% of soil is finer Wg water content D.	C_c		,	
cv coefficient of consolidation V_s volume of solids c cohesion intercept for total stresses V_s volume of voids D diameter of specimen V_w volume of voids D damping ratio V_w volume of water D10 diameter at which 10% of soil is finer V_w velocity D15 diameter at which 15% of soil is finer W_w weight of solids D20 diameter at which 50% of soil is finer W_w weight of water D20 diameter at which 60% of soil is finer W_w water content D3 diameter at which 60% of soil is finer W_w water content D4 diameter at which 60% of soil is finer W_w water content D4 diameter at which 60% of soil is finer W_w water content D4 diameter at which 60% of soil is finer W_w water content D4 displacement for 50% consolidation W_w water content D4 displacement for 100% consolidation W_w final water content	C_{α}	coefficient of secondary compression		
c' cohesion intercept for effective stresses V_v volume of voids D' diameter of specimen V_w volume of voids D diameter of specimen V_w volume of voids D diameter of specimen V_w volume of voids D diameter at which 10% of soil is finer V_w velocity D15 diameter at which 30% of soil is finer W_w weight of solids D26 diameter at which 50% of soil is finer W_w weight of water D80 diameter at which 85% of soil is finer W_w water content D81 diameter at which 85% of soil is finer W_w water content D83 diameter at which 85% of soil is finer W_w water content D84 diameter at which 85% of soil is finer W_w water content D85 diameter at which 85% of soil is finer W_w water content D85 diameter at which 85% of soil is finer W_w water content D86 displacement for 90% consolidation W_w final water content	c_{v}	coefficient of consolidation		e e e e e e e e e e e e e e e e e e e
c' cohesion intercept for effective stresses V.v volume of voids D diameter of specimen V.w volume of water D damping ratio V.v volume of water D10 diameter at which 10% of soil is finer V velocity D10 diameter at which 50% of soil is finer W.w weight of solids D20 diameter at which 50% of soil is finer W.w weight of water D30 diameter at which 60% of soil is finer W.w water content D40 diameter at which 60% of soil is finer W.w water content D40 diameter at which 60% of soil is finer W.w water content D40 displacement for 90% consolidation W.r final water content D40 displacement for 90% consolidation W.r initial water content D4 diardia W.v shrinkage limit D4 void ratio W.v shrinkage limit D5 shear modulus α ' slope of α ' versus pr' D6 shear modulus α '<	c	cohesion intercept for total stresses		
D diameter of specimen V _v volume of water D damping ratio V _o initial volume D ₁₀ diameter at which 10% of soil is finer V volocity D ₂₀ diameter at which 30% of soil is finer W weight of solids D ₂₀ diameter at which 50% of soil is finer W _w weight of solids D ₂₀ diameter at which 50% of soil is finer W _w weight of water D ₂₀ diameter at which 60% of soil is finer W _w water content D ₂₀ diameter at which 85% of soil is finer W _w water content D ₃₀ diameter at which 85% of soil is finer W _w water content D ₃₀ diameter at which 85% of soil is finer W _w water content D ₃₀ diameter at which 85% of soil is finer W _w water content D ₃₀ diameter at which 85% of soil is finer W _w water content D ₄ d ₄ d ₄ d ₄ d ₄ D ₄ void ratio v ₁ d ₄ d ₄	c'	cohesion intercept for effective stresses		•
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$\begin{array}{cccccccccccccccccccccccccccccccccccc$				•
$\begin{array}{cccccccccccccccccccccccccccccccccccc$				e
D8s diameter at which 85% of soil is finer w_c water content at consolidation d_{00} displacement for 50% consolidation w_f final water content d_{00} displacement for 90% consolidation d_{100} displacement for 100% consolidation d_{100} displacement for 100% consolidation d_{100} d_{100} displacement for 100% consolidation d_{100} $d_$				e
$ \begin{array}{c} d_{50} & displacement for 50\% consolidation \\ d_{90} & displacement for 90\% consolidation \\ d_{100} & displacement for 100\% consolidation \\ E & Young's modulus \\ e & void ratio \\ e_c & void ratio after consolidation \\ e_c & void ratio after consolidation \\ e_o & initial void ratio \\ e_o & specific gravity of soil particles \\ H & height of specimen \\ HR & Rebound Hardness number \\ i & gradient \\ Is & Uncorrected point load strength index \\ HA & Modified Taber Abrasion \\ HAT & Total hardness \\ HA & Modified Taber Abrasion \\ HIT & Total hardness \\ K_o & lateral stress ratio for one dimensional strain \\ K & permeability Index \\ mv & coefficient of volume change \\ n & porosity \\ Pc & preconsolidation pressure \\ p & (\sigma_1 + \sigma_3)/2, (\sigma_2 + \sigma_b)/2 \sigma_3 minor principal stress and possible for the first of the $				
$\begin{array}{c} d_{90} & \text{displacement for 90\% consolidation} \\ d_{100} & \text{displacement for 100\% consolidation} \\ d_{100} & \text{displacement for 100\% consolidation} \\ E & Young's modulus \\ e & \text{void ratio} \\ e & \text{void ratio} \\ e & \text{void ratio} \\ e & \text{void ratio difer consolidation} \\ e & \text{shear modulus} \\ G & \text{shear modulus} \\ G & \text{shear modulus} \\ G & \text{specific gravity of soil particles} \\ H & \text{height of specimen} \\ H & \text{Rebound Hardness number} \\ 1 & \text{gradient} \\ 1 & \text{gradient} \\ 1 & \text{gradient} \\ 1 & \text{Size corrected point load strength} \\ 1 & \text{Size corrected point load strength index} \\ 1 & \text{Size corrected point load strength index} \\ 1 & \text{Modified Taber Abrasion} \\ 1 & \text{Modified Taber Abrasion} \\ 1 & \text{Poisson's ratio, also viscosity} \\ 1 & \text{Liquidity Index} \\ 1 & \text{permeability} \\ 2 & \text{gradient} \\ 3 & \text{permeability} \\ 4 & \text{permeability} \\ 5 & \text{permeability} \\ 6 & \text{permeability} \\ 1 & \text{plasticity index} \\ 6 & \text{preconsolidation pressure} \\ 1 & \text{plasticity index} \\ 6 & \text{preconsolidation pressure} \\ 1 & \text{plasticity index} \\ 6 & \text{preconsolidation pressure} \\ 6 & \text{preconsolidation pressure} \\ 7 & \text{gradient} \\ 1 & \text{principal stress} \\ 1 & \text{point of flow} \\ 2 & \text{preconsolidation} \\ 3 & \text{minor principal stress} \\ 4 & \text{principal stress} \\ 5 & \text{preconsolidation} \\ 6 & \text{principal stress} \\ 6 & \text{principal stress} \\ 7 & \text{principal stress} \\ 9 & p$				
$\begin{array}{c} d_{100} & \mbox{displacement for } 100\% \mbox{consolidation} & \mbox{w}_n & \mbox{natural water content} \\ E & Young's modulus & \mbox{w}_p & \mbox{plastic limit} \\ e & \mbox{void ratio} & \mbox{woid ratio} & \mbox{wo, wi} & \mbox{initial water content} \\ e_o & \mbox{initial void ratio} & \mbox{a} & \mbox{slope of } q_r \mbox{versus } p_r \\ e_o & \mbox{initial void ratio} & \mbox{a} & \mbox{slope of } q_r \mbox{versus } p_r \\ e_o & \mbox{initial void ratio} & \mbox{a} & \mbox{slope of } q_r \mbox{versus } p_r \\ e_o & \mbox{slope of } q_r v$		1		
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		•		•
e void ratio w_s shrinkage limit e_c void ratio after consolidation w_o , w_i initial water content e_o initial void ratio a slope of q_f versus p_f g_s specific gravity of soil particles g_s specific gravity of soil parti		•		
$\begin{array}{c} e_c \\ \text{o} \\ \text{initial void ratio} \\ \text{G} \\ \text{Shear modulus} \\ \text{G}_s \\ \text{Specific gravity of soil particles} \\ \text{H} \\ \text{height of specimen} \\ \text{HR} \\ \text{Rebound Hardness number} \\ \text{i} \\ \text{gradient} \\ \text{Is} \\ \text{Uncorrected point load strength} \\ \text{Is} \\ \text{Uncorrected point load strength index} \\ \text{Evol} \\ \text{Volume strain} \\ \text{HA} \\ \text{Modified Taber Abrasion} \\ \text{Eb, Ev} \\ \text{horizontal strain, vertical strain} \\ \text{HT} \\ \text{Total hardness} \\ \text{Ko} \\ \text{lateral stress ratio for one dimensional strain} \\ \text{G} \\ \text{normal stress} \\ \text{It} \\ \text{Liquidity Index} \\ \text{G}_c, \sigma^*_c \\ \text{consolidation stress in isotropic stress system} \\ \text{mv} \\ \text{coefficient of volume change} \\ \text{n} \\ \text{porosity} \\ \text{q} \\ \text{porosity} \\ \text{q} \\ \text{preconsolidation pressure} \\ \text{p} \\ \text{p} \\ \text{($\sigma_1 + \sigma_3$)/2, ($\sigma_v + \sigma_h$)/2} \\ \text{p} \\ \text{p} \\ \text{($\sigma_1 + \sigma_3$)/2, ($\sigma_v + \sigma_h$)/2} \\ \text{p} \\ \text{g} \\ \text{q} \\ \text{($\sigma_1 - \sigma_3$)/2} \\ \text{($\sigma_1 - \sigma_3$)/2} \\ \text{q} \\ \text{minimal stress} \\ \text{q} \\ \text{q} \\ \text{q} \\ \text{friction angle based on total stresses} \\ \text{q} \\ \text{q} \\ \text{q} \\ \text{friction angle based on effective stresses} \\ \text{q} \\ \text{q} \\ \text{q} \\ finitial water content with eight design of qr versus pr design in twe depth of the unit weight of value with total unit weight of value with eight design in tweight of solids unit weight of solids un$		e	•	1
$\begin{array}{c} e_{0} & \text{initial void ratio} \\ G & \text{shear modulus} \\ G_{s} & \text{specific gravity of soil particles} \\ H & \text{height of specimen} \\ H_{R} & \text{Rebound Hardness number} \\ I & \text{gradient} \\ I_{S} & \text{Uncorrected point load strength} \\ I_{S} & \text{Uncorrected point load strength} \\ I_{S} & \text{Uncorrected point load strength index} \\ H_{T} & \text{Total hardness} \\ K_{O} & \text{lateral stress ratio for one dimensional strain} \\ K_{D} & \text{earth of the proposity} \\ E & \text{unit weight of solids} \\ E_{Vol} & \text{volume strain} \\ Volume strain} \\ H_{T} & \text{Total hardness} \\ K_{D} & \text{lateral stress ratio for one dimensional strain} \\ K_{D} & \text{lateral stress ratio for one dimensional strain} \\ K_{D} & \text{permeability} \\ C & \text{ore coefficient of volume change} \\ C & \text{ore, } \sigma^{*}_{C} \\ C & \text{preconsolidation pressure} \\ C & \text{preconsolidation} \\ C & pr$				•
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i gradient γ_{w} unit weight of water Is Uncorrected point load strength ϵ strain ϵ strain Is(50) Size corrected point load strength index ϵ strain ϵ volume strain HA Modified Taber Abrasion $\epsilon_{h}, \epsilon_{v}$ horizontal strain, vertical strain HT Total hardness ϵ lateral stress ratio for one dimensional strain ϵ normal stress ϵ effective normal stress LI Liquidity Index ϵ consolidation stress in isotropic stress system ϵ no porosity ϵ porosity ϵ porosity ϵ preconsolidation pressure ϵ preconsolidation pressure ϵ preconsolidation pressure ϵ preconsolidation pressure ϵ preconsolidation ϵ price price provided in ϵ preconsolidation pressure ϵ preconsolidation pressure ϵ preconsolidation pressure ϵ preconsolidation pressure ϵ preconsolidation ϵ provided in ϵ pro		č i	· ·	
Is Uncorrected point load strength $ε$ strain Is(SO) Size corrected point load strength index $ε$ volume strain HA Modified Taber Abrasion $ε$ h, $ε$ horizontal strain, vertical strain HT Total hardness $μ$ Poisson's ratio, also viscosity Ko lateral stress ratio for one dimensional strain $σ$ normal stress k permeability $σ$ effective normal stress LI Liquidity Index $σ$ coefficient of volume change $σ$ h, $σ$ h horizontal normal stress in isotropic stress system $σ$ voertical normal stress PI plasticity index $σ$ $σ$ effective vertical normal stress PI plasticity index $σ$ $σ$ effective vertical normal stress P $σ$ preconsolidation pressure $σ$ $σ$ effective vertical normal stress P $σ$ preconsolidation pressure $σ$ $σ$ effective vertical consolidation stress P $σ$ preconsolidation pressure $σ$ $σ$ intermediate principal stress P $σ$ $σ$ $σ$ intermediate principal stress P $σ$ $σ$ $σ$ intermediate principal stress P $σ$ $σ$ $σ$ $σ$ intermediate principal stress P $σ$ $σ$ $σ$ $σ$ intermediate principal stress P $σ$			•	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		E	•	
HAModified Taber Abrasion $ε_h$, $ε_v$ horizontal strain, vertical strainHTTotal hardness $μ$ Poisson's ratio, also viscosityK₀lateral stress ratio for one dimensional strain $σ$ normal stresskpermeability $σ'$ effective normal stressLILiquidity Index $σ_c$, $σ'_c$ consolidation stress in isotropic stress system m_v coefficient of volume change $σ_h$, $σ'_h$ horizontal normal stressnporosity $σ_v$, $σ'_v$ vertical normal stressPIplasticity index $σ'_v$ Effective vertical consolidation stressPcpreconsolidation pressure $σ_1$ major principal stressp $(σ_1 + σ_3)/2$, $(σ_v + σ_h)/2$ $σ_2$ intermediate principal stressp' $(σ'_1 + σ'_3)/2$, $(σ'_v + σ'_h)/2$ $σ_3$ minor principal stressp'p' at consolidation $τ$ shear stressQquantity of flow $φ$ friction angle based on total stressesq $(σ_1 - σ_3)/2$ $φ'$ friction angle based on effective stressesqfq at failure $φ'_r$ residual friction angleqo, qiinitial q $φ_{ult}$ $φ$ for ultimate strength	-		3	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$			ϵ_{vol}	
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$			ϵ_h, ϵ_v	
k permeability σ' effective normal stress σ_c, σ'_c consolidation stress in isotropic stress system σ_c, σ'_c consolidation normal stress σ'_c, σ'_c vertical normal stress σ'_c, σ'_c vertical normal stress σ'_c, σ'_c effective vertical consolidation stress σ'_c, σ'_c effective vertical consolidation stress σ'_c, σ'_c effective vertical consolidation stress $\sigma'_c, \sigma'_c, \sigma'_c, \sigma'_c, \sigma'_c$ effective vertical consolidation stress $\sigma'_c, \sigma'_c, \sigma'_$	-		μ	
LI Liquidity Index m_v coefficient of volume change m_v consolidation remal stress m_v coefficient of volume change m_v coefficient of volume change m_v consolidation stress m_v coefficient of volume change m_v coefficient of volution angle based on total stress of the vertical consolidation stress m_v coefficient of volume change m_v coefficient of volution angle based on effective stresses m_v coefficient of volume change m_v coefficient of volume change m_v consolidation stress in isotropic stress system m_v coefficient of volution angle stress m_v coefficient of volume change m_v coefficient of volution stress of the vertical consolidation stress m_v coefficient of volution stress m_v co	-			
mover coefficient of volume change σ_h, σ'_h horizontal normal stress σ_h, σ'_h vertical normal stress σ'_h, σ'_h vertical consolidation stress σ'_h, σ'_h major principal stress σ'_h, σ'_h major principal stress σ'_h, σ'_h major principal stress σ'_h, σ'_h minor principal stress σ'_h, σ'_h minor principal stress σ'_h, σ'_h p' at consolidation σ'_h, σ'_h shear stress σ'_h, σ'_h p' at consolidation σ'_h, σ'_h p' and σ'_h, σ'_h friction angle based on total stresses $\sigma'_h, \sigma'_h, \sigma'_h$ p' friction angle based on effective stresses $\sigma'_h, \sigma'_h, \sigma'_h$ p' residual friction angle σ'_h, σ'_h p' for ultimate strength		•	σ'	
n porosity σ_{v} , σ_{v} vertical normal stress PI plasticity index σ_{v} , σ_{v} vertical normal stress Effective vertical consolidation stress σ_{v} Effective vertical consolidation stress σ_{v} major principal stress σ_{v} intermediate principa		1 ,	σ_c, σ'_c	consolidation stress in isotropic stress system
PI plasticity index σ'_{vc} Effective vertical consolidation stress σ'_{vc} preconsolidation pressure σ_1 major principal stress σ_2 intermediate principal stress σ'_{vc} principal stress σ'_{vc} σ'_{vc} intermediate principal stress σ'_{vc} σ'_{vc} principal stress principal stress principal stres		<u> </u>	σ_h, σ'_h	horizontal normal stress
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		•	σ_v, σ'_v	vertical normal stress
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		± •	σ'_{vc}	Effective vertical consolidation stress
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	P_c	•	σ_1	major principal stress
$\begin{array}{cccccccccccccccccccccccccccccccccccc$			σ_2	intermediate principal stress
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	p'		σ3	minor principal stress
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	p'c	•	τ	shear stress
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	Q	1 7	φ	friction angle based on total stresses
q_f q at failure ϕ'_r residual friction angle q_0, q_i initial q ϕ_{ult} ϕ for ultimate strength	q		•	friction angle based on effective stresses
q_o,q_i initial q ϕ_{ult} ϕ for ultimate strength	q_{f}	•		e e e e e e e e e e e e e e e e e e e
	q_o, q_i	•		
	q_c	q at consolidation	•	-