EPILOGUE: 2018-2019 ASCE Geo-Institute Cross-USA Lecture Series
Speaker: Paul W. Mayne, PhD, P.E., M.ASCE, Georgia Institute of Technology

Locations of Talks

Epilogue: locations of the 2018-2019 Cross-USA Lecture (red) and other events (blue)

TOPICS for ASCE Geo-Institute Cross-USA Lecture (2018-2019)

Topic 1. Yield Stress of Soils from Cone Penetration Tests

(2009 SOA-ICSMGE; 2014 GSP Paper from GeoCongress - Atlanta; 2017 Manuel Roche Lecture, Lisbon and paper in *Soils & Rocks 2017; 2018 GEESD-V Austin;* 2019 JGGE Paper)

Abstract. Stress history is an important measurement in soils as it affects strength, stability, stiffness, and flow characteristics. The evaluation of the in-situ preconsolidation stress, or effective yield stress, from the results of piezocone penetration tests allows for an economical and expedient means to profile the stress history of clays, silts, sands, and mixed soil types on geotechnical projects. The methodology is initally based on a derived analytical cavity expansion - critical state solution for clays which was calibrated using data from 206 sites. Then statistical inversion of data from 706 calibration chamber tests on sands. Applications are given for case studies involving clay, silt, and sand where laboratory consolidation tests and/or geologic stress history provide benchmark values for the yield stress profiles. Since yield stress demarcates contractive *vs.* dilative soil behavior, it is shown that the methodology can screen soil susceptibility concerns involving both flow and cyclic liquefaction, with several case studies shown relative to conventional approaches.

Keywords: clay, cone penetration, liquefaction, overconsolidation, piezocone, preconsolidation, sand, stress history, yield stress.

Topic 2. Seismic piezocone testing – the versatile and complete means for geotechnical site exploration in 2019 (update of keynotes from ASCE SOA on In-Situ Testing 2012, Oakland and 3rd Intl. Symposium on Cone Penetration Testin CPT'14, Las Vegas)

ABSTRACT: Towards geotechnical site characterization, seismic piezocone penetration testing (SCPTu) offers up to five separate measurements with depths from a single sounding: cone tip resistance (q_t), sleeve friction (f_s), porewater pressure (u_2), time rate dissipation (t_{50}), and shear wave velocity (V_s). Thus it is an expedient and economical means for obtaining stratification of the ground and the determination of a variety of soil engineering parameters for analysis and design, including nonlinear stress-strain-strength curves for clays and sands. Calibration and documentation of selected geoparameters are presented with statistical datasets. Moreover, direct CPT methodologies have been developed for application to shallow footings, piling foundations, and seismic liquefaction evaluation. Case studies are presented to show the utilization of SCPTu in geotechnics.

Topic 3. Effective Stress Friction Angle of Sands and Clays from Cone, Piezocone, & Flat Dilatometer (papers in ICE Geotechnical Engineering 2017; Canadian Geotech Journal - Sept 2018, ASTM Geot Testing Journal, 2018; ICSMGE Proceedings from Seoul 2017)

We start out with review of frictional characteristics of clean sands, then add dilatancy effects, and CPT expressions. We now have 57 triaxials on 26 undisturbed sands with CPT data (update from 2006 James K Mitchell Lecture) and then expand into the NTH effective stress limit plasticity solution which requires piezocone penetration testing (CPTu). We have calibrated NTH solution for clays and clayey silts using CPTu data from 1-g chamber tests (11 series), mini-CPTu in centrifuge (12 series), and standard CPTu at 105 field sites with companion lab CIUC/CAUC. In addition, twitch CPTu testing allows rates to be adjusted so that the behavior switches from undrained to partially-drained to fully-drained response. The NTH solution still works !. Using a CPTu-DMT nexus, we can make equivalent Q and Bq from DMT and then apply similar NTH solution to DMTs in soft-firm clays with supporting database from 42 sites.

Topic 4. Evaluation of axial pile response for load-displacement-capacity and load transfer using seismic piezocone tests (Update of 2009 Mike O'Neill Lecture *in DFI Journal*; paper by Niazi & Mayne in *Engineering Geology 2016; IFCEE* Orlando 2017)

For deep foundations, cone penetrometer (CPT) and piezocone (CPTu) data can be used in either traditional bearing capacity solutions via interpreted geoparameters, or alternatively with direct-CPT methods that scale the measured cone tip resistance and sleeve friction to unit end and unit side resistances of the full-scale pile foundation. A Modified Unicone Method is presented based on 330 pile load tests, compared with 105 load tests for the original Unicone Method. With seismic piezocone tests (SCPTu), the small-strain stiffness (G_0) is obtained from the shear wave velocity measurement. A modulus reduction curve can be expressed in terms of the mobilized load (Q/Q_{ult}) which is in essence, the factor of safety. Introducing closed-form elastic solutions for axial pile displacement and load-transfer with depth, the use of SCPTu permits a construction of the load-displacement-capacity curves and axial load distribution for driven, jacked, and drilled pile foundations. Case studies from South Carolina, Georgia, British Columbia, Texas, Alabama, and Alberta are presented.

Topic 5. Analytical Cavity Expansion-Critical State Model for Normal, Sensitive, and Organic Clays *(Canadian Geotechnical Journal 2017; Proc. GeoEdmonton 2018; Proc. ECSMGE 2019)*

This shows the analytical hybrid formulation of a simple SCE-CSSM model for evaluating OCR, rigidity index (IR = G/su), and su in clays which works nicely for "vanilla" type clays, but then does not work when organic soils and/or sensitive clays are encountered (those now organized into separate databases). This becomes a simple screening tool for the CPTu since soil behavioral type charts often do not identify organic clays or sensitive clays. Applying a small adjustment obtains a modified SCE-CSSM solution (uses the effective ϕ' at peak strength and also ϕ' at large strains)

for sensitive and/or structured clays. We have now several nice examples, including the sensitive Champlain Sea clay at the Canadian Test Site 1 in Ontario (CGJ 2017), sensitive Haney clay in BC (GeoEdmonton 2018 paper); and sensitive Tiller clay in Norway (2019 ECSMGE Paper with NGI), and several others (Boston Blue Clay, Amherst/MA, and Presumpscot clay in Maine). For the organic clays, an empirical approach is offered with some ideas towards a SCE-CSSM version for those too.

Topic 6. Overview on Geocharacterization by In-Situ Tests

Based on research for the new manual on Geotechnical Site Characterization written for AASHTO (2019) and prior manuals for the NHI = National Highway Institute (2002) and FHWA = Federal Highway Administration (2002) concerning geotechnical site investigation. Part 6a. Includes a brief overview on electromagnetic geophysics (GPR, EM, Resistivity) and mechanical wave geophysics: SRF, CHT, DHT, SASW, MASW) and Part 6b: the basic in-situ tests, including SPT, CPT, DMT, PMT, VST, SCPTu, SDMT) - maybe 1.5 hours.

Topic 7. Critical State Soil Mechanics for Dummies

An overview on the effective stress framework called critical state soil mechanics (CSSM) that links one dimensional consolidation behavior with shear strength of soils (i.e. Mohr's circles), including clays, silts, and sands, as well as mixed soil types. Helps explain concepts of "undrained" versus "drained" and the nexus between them. All shown graphically without the awesome mathematics that also exists. Clarifies the notions of normally consolidated vs. overconsolidated, positive and negative porewater pressures, undrained shear strength, drained shear strength, contractive vs. dilative soil behavior, yield surface, and more.

http://geosystems.ce.gatech.edu/Faculty/Mayne/papers/index.html

Topic 8. GeoEducation – Time to Revamp our Curriculum in Geotechnics

(based on *Shaking the Foundations of Geotechnical Engineering*, Galway 2012 and proceedings paper in GeoCongress 2014 GSP 234)

ABSTRACT: The majority of civil engineering curricula at US universities have an introductory course on geotechnical engineering that emphasizes a laboratory-based approach to soil mechanics. The same topics and subject matter are nearly identical to those covered in classes from 1925 to 1960. The reality of today's professional practice, however, relies more on field testing data for ascertaining soil engineering design parameters. Therefore, a more balanced approach is warranted with course modules covering topics on in-situ testing, field geophysics, and laboratory methods to better poise civil engineering graduates in assessing site conditions, soil parameters, problematic ground, and finding geotechnical solutions. Current curricula should also stop promoting overuse of plasticity index (PI), SPT-N values, and other simplifications in geoparameter evaluations.

Topic 9: Direct CPT methods for shallow footings (Part 1) and deep foundations (Part 2). (Proc. IFCEE GSP 2018; GSP 234; Proc. GeoCongress Atlanta 2014; Proc. CPT'10 Huntington Beach CA).

ABSTRACT: Part 1. The use of applied foundation stress versus normalized displacement curves (q vs. s/B) is applied to footings on sands, silts, intact clays, and fissured clays, all subjected to cone penetration testing (CPT). A square root plotting of the normalized displacements (s/B) permits a single parameter characterization for each specific soil type, that in turn, tracks with the net cone tip resistance. Using the concept of a characteristic load-displacement curve for shallow foundations, a direct design method based on CPT is applied to a database compiled from a total 130 footings on sands. Performance results are based solely on field load test data from large foundations (B > 0.5 m) in order to avoid known scaling effects from small model size footings. The method is extended to other soil types,

include load tests on 67 large footings and plates. These include a listing of 32 foundations on 13 sands, 11 footings on 4 silt deposits, 12 footings or large plate load tests on 6 intact clays, and 11 foundations on 5 fissured clays. Limited data from 8 footings on calcareous sands also show compatibility with the derived algorithm.

ABSTRACT: Part 2: Using a large database derived from 330 full scale load tests on axially loaded pile foundations, a more refined direct cone penetration test (CPT) method of pile capacity analysis is developed from the 1997 UniCone approach proposed by Eslami and Fellenius (1997). A larger database permits separation of pile type and installation method: drilled, augered, jacked, and driven. It is found that the original 5-part zonal soil behavior classification by piezocone test (CPTu) can be subdivided into finer categories of soil type. Furthermore, the pile side coefficient (Cse) linking effective cone resistance (qE = qt – u2) to pile unit shaft resistance (fp = Cse qE) can be related as a continuous function, rather than just five discrete values. For both toe resistance and side resistance, C_{te} and C_{se} are shown to relate to the CPT material index (Ic) which is well-known and utilized for identifying soil behavioral type.

Topic 10: Geotechnics 2019 in the Appalachian Piedmont and Blue Ridge Provinces

Mayne, Brown, Vinson (2000, GSP 93); Mayne & Brown (Characterization & Engrg Properties of Natural Soils, 2003); Mayne (2005, IJGCH); Brown & Mayne (GeoStrata 2012);

The Appalachian Piedmont and Blue Ridge are comprised of residual soils, saprolites, and parent bedrocks of metamorphic and igneous origins. While site investigation in the Piedmont and Blue Ridge is still dominated by auger borings and SPT, there are certainly advantages of using more modern in-situ tests, including CPT, CPTu, DMT, PMT, and shear wave velocity (Vs). Of particular value are seismic piezocone (SCPTu) and seismic flat dilatometer tests (SDMT) as up to 5 measurements with depth are obtained from a single sounding. Applications of these in-situ tests include improved evaluations with higher reliability on the estimated foundation response, including capacity and displacements of shallow footings, mats, and deep foundations. Case studies are interwoven to show their applicability in these geologic settings, including load tests by top-down, bi-directional O-cells, and settlement monitoring.

From left to right: Andrew Whittle (MIT: 2017-2018 ASCE G-I Cross USA Lecturer; John Wolosick (Hayward-Baker: DFI Cross Country Lecturer 2018-2019); and Paul W. Mayne (GT: 2018-2019 ASCE G-I Cross USA Lecturer)

CHRONOLOGY OF EVENTS: 2018-2019 ASCE G-I Cross USA Lectures

Updated June 2019

LEGEND

Highlighted in purple (Completed)	Highlighted in green (other events)
Highlighted in red (planned)	Brown (not yet verified)

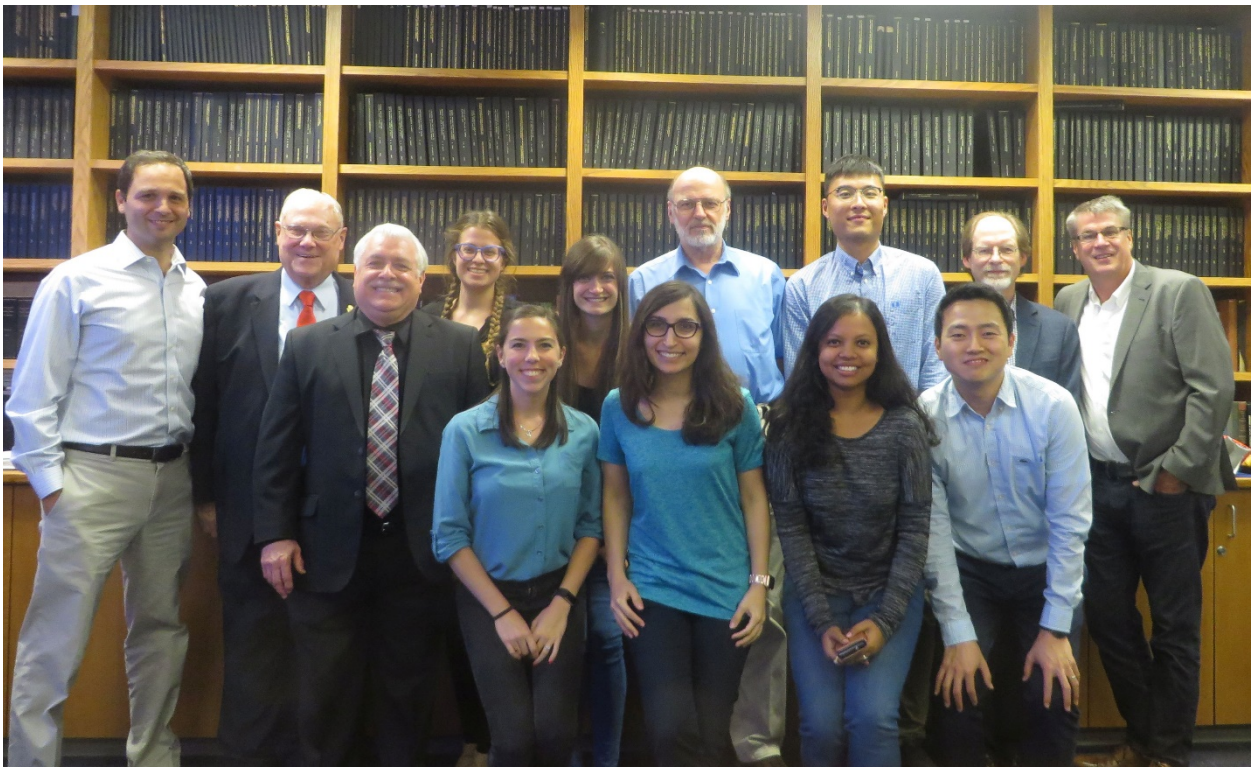
2018-2019 Cross - USA Lecture	Paul W. Mayne, PhD, P.E.	TOPIC	Location and Remarks	Contact Person
AUGUST 2018	*Classes*		Fall 2018 Semester Classes on Tuesday & Thursday mornings	
20	21 22 23 24 25		CEE 6423 - Geot Foundations - 09:30-10:45 EST L-1125	
26	20 21 22 23 **31** **1**			
SEPTEMBER 2018				
Sunday	**Monday** **Tuesday** **Wednesday** **Thursday** **Friday** **Saturday**		Sept 03 - Labor Day	
2	3 4 5 6 7 8	2	Sept 7 - Univ. Michigan, Ann Arbor	Andrea Ventola <acvent@umich.edu>
9	10 11 12 13 14 15			
16	17 18 19 20 21 22			
23	24 25 26 27 28 29		23-26 Sept 2018: GeoEdmonton - 71st Canadian Geot Conf.	Elwood, David <david.elwood@usask.ca>
OCTOBER 2018				
30	1 2 3 4 5 6			
7	8 9 10	2	Oct 10 - Oregon G-I; Portland; **(GT Fall Recess)**	Heidari, Maddie/PDX <Maddie.Heidari@jacobs.com>
	11 12 13	5	Oct 11 - Oregon State, Corvallis	Stuedlein, Armin <Armin.Stuedlein@oregonstate.edu>
14	15 16 17 18 19 20			
21	22 23 24 25 26 27	2	26 Oct - Univ. Illinois Urbana-Champaign	Hashash, Youssef M A <hashash@illinois.edu>
28	29 30 31 1 2 3	4	02 November - St. Louis Chapter	Hill, Jeff <JRHill@HaywardBaker.com>
NOVEMBER 2018				Pat Kinsella <PMK@shanwil.com>
4	5 6 7 8 9 10	3	09 November - NCSU - Raleigh, North Carolina	Ashkan Nafisi <anafisi@ncsu.edu>
11	12 13 14 15 16 17			
18	19 20 21 22 23 24		Thanksgiving Holiday	
25	26 27 28 29 30 1	2	29 Nov - 30 Nov - Spencer Buchanan Lecture at Texas A&M Univ.	Melanie Rodriguez <mrodriguez@civil.tamu.edu>
DECEMBER 2018				
2	3 4 5 6 7 8	2	Central Ohio G-I, Columbus	Pradel, Daniel <pradel.1@osu.edu>
9	10 11 12 13 14 15		Final Exams and Commencement - PhD on 14 Dec 2018	
16	17 18 19 20 21 22			
23	24 25 26 27 28 29		Christmas Holidays	
JANUARY 2019				
30	31 1 2 3 4 5		New Year's	
6	7 8 9 10 11 12		Spring 2019 classes begin	
13	14 15 16 17 18 19	6	15 Jan. - Arizona G-I Chapter-Phoenix	Jeffrey Rodgers <jrodgers@ninyoandmoore.com>
		7	16 January - Arizona State University, Tempe	Edward Kavazanjian <Edward.Kavazanjian@asu.edu>
20	21 22 23 24 25 26		Martin Luther King Holiday on 21 Jan 2019	
27	28 29 30 31 1 2	9	29 Jan.- Florida West G-I, Tampa	Basnett, Curt/TPA <Curt.Basnett@jacobs.com>
		4	31 Jan. - East Central Florida G-I, Orlando	Jammal, Elias N. <Elias.Jammal@terracon.com>
FEBRUARY 2019				Bill Fox <bfox@smeinc.com> Orlando
3	4 5 6 7 8 9	9	08 Feb 2019 - Geo-Omaha 2019 - 36th Nebraska Conference	Kristle Beaudet <geoomahaneasce@gmail.com>
10	11 12 13 14 15 16	1	14 Feb - Talk at Geosyntec	
17	18 19 20 21 22 23	9	20 Feb 2019: Univ. Arkansas, Fayetteville	Anibal Santos <aesantos@email.uark.edu>
24	25 26 27 28 1 2		GT Geofaculty Retreat on 22 Feb and Meeting on 26 Feb 2019	
MARCH 2019			**March 8 = Frankie's PhD Defense**	Cummins, Rebecca <Rebecca.Cummins@terracon.com>
3	4 5 6 7 8 9	10	GeoCarolinas on 05 March 2019 in Charlotte, NC	Billy Camp <bcamp@smeinc.com>
10	11 12 13 14 15 16	4*	*Cancelled: 14 March - Pittsburgh G-I Section	Braun, Greg <Gregory.D.Braun@usace.army.mil>
17	18 19 20 21 22 23	2	20 March - RPI, Troy New York	Tom Zimmie: zimmit@rpi.edu
24	25 26 27 28 29 30		24-27 March - ASCE GeoCongress, Philadelphia	
Sunday	**Monday** **Tuesday** **Wednesday** **Thursday** **Friday** **Saturday**			
APRIL 2019			02 April - GT Geofaculty Meeting	
31	1 2 3 4 5 6	8	04-05 April Kansas City annual conference on Friday (dinner Thursda	Joe.Waxse@terracon.com
7	8 9 10 11 12 13	1	09 April - Case Western	Xiong (Bill) Yu <xxy21@case.edu>
		6	09 April - Cleveland ASCE G-I Section, Ohio	Shafer, Zachery <Zachery.Shafer@aecom.com>
14	15 16 17 18 19 20	2	16 April Tuesday - UCSD-San Diego	Muhammad Zayed <mzayed@eng.ucsd.edu>
21	22 23 24 25 26 27	4 and 7	24 April 2019: Utah G-I, Salt Lake City: UDOT Facility (2 hours)	Ryan Maw <ryanm@gerhartcole.com>
28	29 30 1		**PhD Commencement on 03 May 2019**	
	2 3 4	6a	30 April - Central New York G-I at Syracuse University	DHollander, Ray <ray.dhollander@parsons.com>
MAY 2019		6b	(6a = geophysics; 6b = in-situ tests)	
5	6 7 8 9 10 11		Sowers Symposium for ASCE Atlanta G-I Section and Georgia Tech	
12	13 14 15 16 17 18		Enhanced In-Situ Testing Course at GT Global Learning Center	Robin.Finey@pe.gatech.edu
19	20 21 22 23 24 25		CPT Seminar in Seattle May 21 and Chicago May 23	
26	27 28 29 30 31 1			

Seminar Talk at UCSD

Paul and Muhammad at Fallen Star on UCSD campus

Group at NCSU, Raleigh

Dinner with Univ. Arkansas Group



Visit to University of Michigan Geotechnical Group