Liquefaction Spreadsheet - based on Boulanger and Idriss (2014)

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Simplified Procedure - Standard Penetration Test Analysis

note applicible to sloping ground surfaces greater than about 6%

To run, need to go to Option->Formulas->Enable Iteration Calculations with 0.00001 tolerance and 100 iterations.

Only need input blue highlighted cells

Moment Magnitude, M_w =	7.7		depth to design grade =	0	ft	Hammer Type =		1		C_E =	1.48
PGA =	0.6	g	uniform floor load =	0	lb/ft^2	Borehole Diameter =		3	inches	C_B =	1
depth to groundwater during drilling =	18	ft	assumed depth to groundwater =	18	ft	SPT sampler (Y/N)=		N		C_S	
estimated age of sand deposit =	1500	years				Rod length above ground =	3.500	ft	1.0668 m	C_R	
						Hammer Energy Ratio =		1.48			

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Depth		Required Input Data					design			Cyclic Stress Ratio		Correction Factors						Analysis based on SPT Blow Counts							
sample depth	Depth	1=CL,ML,CH	γ_t	Field "N"	Fines	PI	s_{vo}	s'_{vo}	s'_{vo}	r_d	CSR	C_E	m	C_N	C_S page 73 of Idriss and Boulanger (2008)	C_B	C_R	$(N_1)_{60}$	$\Delta(N_1)_{60}$ for fine content (Triggering) Eq. (2.23)	$(N_1)_{60cs}$	K_s	$CRR_{7.5}$ for M=7.5 and 1atm Eq. 2.25	MSF Fig 2.5, Eqs 2.19, 2.21	$CRR_{7.5}$	FS
(ft)	(m)	2=SP,SM,SC	(lb/ft^3)	(bpf)	%	%	(lb/ft^2)	(lb/ft^2)	(tsf)	Eq. (2.14)	Eq. (2.2)		Eq. 2.15(a and c)					(bpf)		(bpf)	Eq. 2.16			corrected	
1	0.30	CH	120	9	95	10	120	120	0.06	1.00	0.392	1.48	n.a.	n.a.	n.a.	1.00	0.75	n.a.	n.a.	n.a.	n.a.	n.a.	0.99	n.a.	n.a.
3.5	1.07	ML	120	8	95	10	420	420	0.21	1.00	0.390	1.48	0.413	1.700	1.178	1.00	0.75	17.78	5.50	23	1.10	0.2544	0.96	0.268	n.a.
6	1.83	ML	120	7	95	10	720	720	0.36	0.99	0.388	1.48	0.443	1.603	1.142	1.00	0.75	14.22	5.50	20	1.10	0.2026	0.97	0.216	n.a.
8.5	2.59	SM	120	5	12	5	1020	1020	0.51	0.99	0.385	1.48	0.523	1.455	1.100	1.00	0.80	9.47	2.07	12	1.06	0.1291	0.99	0.135	n.a.
13.5	4.11	SM	120	19	12	0	1620	1620	0.81	0.98	0.380	1.48	0.324	1.086	1.300	1.00	0.85	33.74	2.07	36	1.06	1.3213	0.92	1.295	n.a.
18.5	5.64	SM	120	10	12	0	2220	2189	1.09	0.96	0.380	1.48	0.458	0.979	1.160	1.00	0.95	15.96	2.07	18	0.99	0.1840	0.97	0.178	0.4688163
23.5	7.16	SM	120	14	12	0	2820	2477	1.24	0.94	0.419	1.48	0.403	0.934	1.225	1.00	0.95	22.51	2.07	25	0.97	0.2805	0.95	0.261	0.6231357
28.5	8.69	SM	120	14	12	0	3420	2765	1.38	0.93	0.447	1.48	0.413	0.891	1.213	1.00	0.95	21.26	2.07	23	0.96	0.2553	0.96	0.235	0.5262917
33.5	10.21	SM	120	25	12	0	4020	3053	1.53	0.91	0.466	1.48	0.266	0.904	1.300	1.00	1.00	43.49	2.07	46	0.89	2.0000	0.92	1.638	2
38.5	11.73	SM	120	16	12	0	4620	3341	1.67	0.89	0.479	1.48	0.387	0.834	1.246	1.00	1.00	24.60	2.07	27	0.92	0.3357	0.95	0.294	0.6147311
43.5	13.26	SP-SM	120	16	5	0	5220	3629	1.81	0.87	0.487	1.48	0.414	0.796	1.232	1.00	1.00	23.21	0.00	23	0.92	0.2532	0.96	0.223	0.4573331
48.5	14.78	SP-SM	120	19	5	0	5820	3917	1.96	0.85	0.491	1.48	0.373	0.791	1.286	1.00	1.00	28.60	0.00	29	0.88	0.4095	0.94	0.339	0.6914746
53.5	16.31	SP-SM	120	14	5	0	6420	4205	2.10	0.83	0.492	1.48	0.461	0.724	1.177	1.00	1.00	17.65	0.00	18	0.91	0.1802	0.97	0.161	0.3263223
58.5	17.83	SP-SM	120	26	5	0	7020	4493	2.25	0.81	0.491	1.48	0.300	0.795	1.300	1.00	1.00	39.76	0.00	40	0.77	2.0000	0.92	1.428	2
78.5	23.93	SP	120	16	0	0	9420	5645	2.82	0.73	0.475	1.48	0.462	0.632	1.176	1.00	1.00	17.59	0.00	18	0.88	0.1796	0.97	0.154	0.3240032
98.5	30.02	SP	120	26	0	0	11820	6797	3.40	0.67	0.455	1.48	0.339	0.670	1.300	1.00	1.00	33.52	0.00	34	0.71	0.8313	0.92	0.548	1.2052124

CRR=Cyclic Resistance Ratio

CSR=Cyclic Stress Ratio

1 TSF = 96 kPa

1 TSF = 2000 lb/ft^2

2000 lb/ft^2 = 95.76 kPa

100 kPa = 200000/96 lb/ft^2

2088.55

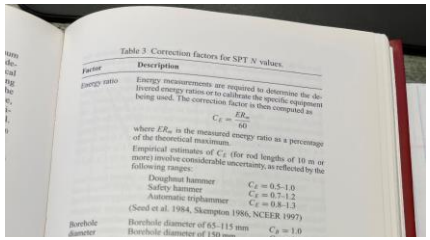
Table 3 Correction factors for SPT N values.

Factor	Description
Energy ratio	Energy measurements are required to determine the delivered energy ratios or to calibrate the specific equipment being used. The correction factor is then computed as $C_E = \frac{ER_m}{60}$ where ER_m is the measured energy ratio as a percentage of the theoretical maximum. Empirical estimates of C_E (for rod lengths of 10 m or more) involve considerable uncertainty, as reflected by the following ranges: Donghut hammer $C_E = 0.5–1.0$; Safety hammer $C_E = 0.7–1.2$; Automatic triphammer $C_E = 0.8–1.3$ (Seed et al. 1984, Skempton 1986, NCEER 1997)
Borehole diameter	Borehole diameter of 65–115 mm $C_B = 1.0$; Borehole diameter of 150 mm