SIMPLIFIED EVALUATION OF SITE CLASS AND GEOTECHNICAL DESIGN PARAMETERS USING STANDARD PENETRATION TEST (SPT) DATA

PROJECT INFORMATION

Project Name	
Project No.	
Project Location	
Analyzed By	
Reviewed By	

GENERAL INPUT DATA

Analysis Description	
Boring ID No.	BH-1
Ground Surface Elevation	100.0 feet
Proposed Grade Elevation	100.0 feet
Total Unit Weight of New Fill	120.0 pcf
Borehole Diameter	8.0 inches
Hammer Weight	140.0 pounds
Hammer Drop	30.0 inches
Hammer Efficiency Ratio, ER	80.0 %
Hammer Dist. to Ground Surface	5.0 feet
Groundwater Depth During Test	80.0 feet

SHEAR WAVE VELOCITY DERIVED FROM SPT DATA

- Based on the recommendations by Idriss and Boulanger (2008), the normalized SPT blow count is defined as $(N_1)_{60} = N_{60}\ C_N$

  where $N_{60} = N_{field}\ C_E\ C_B\ C_R\ C_S$

  and the relative density of granular soils is estimated as

  $D_r = 15\ [(N_1)_{60}]^{0.5}$ in percent

- Shear wave velocities are estimated using the empirical correlations with SPT N_{60} values for various soil types, as derived by Brandenberg et al. (2010).

SITE CLASS EVALUATION

Site class is determined based on Section 20.3 of ASCE 7-22.

Estimated V_{s30} :	906 feet/sec
Site Class Based on V_{s30} :	D
Site Class Based on (V_{s30}) x 1.3 :	CD
Site Class Based on (V_{s30}) / 1.3 :	D

SOIL STRENGTH AND DEFORMATION MODULUS PARAMETERS

- For granular soils, effective peak friction angle, ϕ', is estimated from correlations with the normalized SPT blow count, $(N_1)_{60}$ from Bowles (1996) and recommended adjustments from Caltrans Geotechnical Manual (2014).
- For cohesive soils, undrained shear strength, S_u are estimated using the correlation chart $(N_1)_{60}$ value provided in the Caltrans Geotechnical Manual (2014).
- Modulus of Elasticity, E_s, values for granular soils and cohesive soils are estimated from correlations with SPT N_{60} and undrained shear strength, S_u, respectively summarized by Bowles (1996).
- Shear Modulus, $G = E_s / [3\ (1 - 2\mu)]$ and Bulk Modulus, $K = E_s / [2\ (1 + \mu)]$ based on theory of elasticity where μ is the Poisson's ratio of the soil. Typical values of Poisson's ratio are estimated from various references.

REFERENCES:

1. AASHTO, 1988. Manual on Subsurface Investigations.
2. ASCE 7-22 Minimum Design Loads for Buildings and Other Structures.
3. Brandenberg, S.J., Bellana, N. and Shantz, T., 2010. "Shear Wave Velocity as a Statistical Function of Standard Penetration Test Resistance and Vertical Effective Stress at Caltrans Bridge Sites," PEER Report 201/03.
4. FHWA, 2002. Subsurface Investigations Reference Manual, Geotechnical Site Characterization.
5. Idriss, I.M. and Boulanger, R.W., 2008, "Soil Liquefaction During Earthquakes", EERI Monograph MNO-12.

INPUT SOIL PROFILE DATA

Depth to Top of Soil Layer (feet)	Depth to Bottom of Soil Layer (feet)	Soil Type USCS Group Symbol (ASTM D2487)	Total Soil Unit Weight γ_t (pcf)	Type of Soil Sampler	Field Blow Count N_{field} (blows/ft)
0.0	5.0	SM	120.0	MCal	12.0
5.0	10.0	CL	120.0	MCal	10.0
10.0	15.0	CL-ML	120.0	MCal	15.0
15.0	20.0	SM	120.0	SPT1	25.0
20.0	25.0	SW-SM	120.0	MCal	30.0
25.0	30.0	ML	120.0	SPT1	18.0
30.0	35.0	ML	120.0	SPT1	12.0
35.0	40.0	CL	120.0	SPT1	22.0
40.0	45.0	SM	120.0	SPT1	35.0
45.0	50.0	SM	120.0	SPT1	40.0
50.0	60.0	SM	120.0	SPT1	48.0
60.0	70.0	SP	125.0	SPT1	56.0
70.0	80.0	SP	125.0	SPT1	56.0
80.0	90.0	SP	125.0	SPT1	56.0
90.0	100.0	SP	125.0	SPT1	56.0

Bottom of Soil Layer Elevation (feet)	Soil Depth During Test (feet)	SPT Corr. For Vert. Stress C_N	SPT Corr. For Hammer Energy C_E	SPT Corr. For Borehole Size C_B	SPT Corr. For Rod Length C_R	SPT Corr. For Sampling Method C_S	Corrected SPT Blow Count N_{60} (blows/ft)	Normalized SPT Blow Count $(N_1)_{60}$ (blows/ft)	Apparent Density / Soil Consistency Description FHWA (2002) and AASHTO (1988)
95.0	2.5	1.700	1.333	1.150	0.750	0.650	9.0	15.0	Loose Sand
90.0	7.5	1.491	1.333	1.150	0.800	0.650	8.0	12.0	Medium Stiff Clay
85.0	12.5	1.155	1.333	1.150	0.850	0.650	13.0	15.0	Stiff Clay
80.0	17.5	0.976	1.333	1.150	0.950	1.000	36.0	35.0	Dense Sand
75.0	22.5	0.861	1.333	1.150	0.950	0.650	28.0	24.0	Medium Dense Sand
70.0	27.5	0.778	1.333	1.150	0.950	1.000	26.0	20.0	Very Stiff Silt
65.0	32.5	0.716	1.333	1.150	1.000	1.000	18.0	13.0	Very Stiff Silt
60.0	37.5	0.667	1.333	1.150	1.000	1.000	34.0	23.0	Hard Clay
55.0	42.5	0.626	1.333	1.150	1.000	1.000	54.0	34.0	Very Dense Sand
50.0	47.5	0.592	1.333	1.150	1.000	1.000	61.0	36.0	Very Dense Sand
40.0	55.0	0.550	1.333	1.150	1.000	1.000	74.0	41.0	Very Dense Sand
30.0	65.0	0.506	1.333	1.150	1.000	1.000	86.0	43.0	Very Dense Sand
20.0	75.0	0.469	1.333	1.150	1.000	1.000	86.0	40.0	Very Dense Sand
10.0	85.0	0.447	1.333	1.150	1.000	1.000	86.0	38.0	Very Dense Sand
0.0	95.0	0.434	1.333	1.150	1.000	1.000	86.0	37.0	Very Dense Sand

ESTIMATED GEOTECHNICAL DESIGN PARAMETERS

Bottom of Soil Layer Elevation (feet)	Relative Density D_r (%)	Shear Wave Velocity V_s (ft/s)	Effective Peak Friction Angle ϕ' (deg)	Undrained Shear Strength S_u (ksf)	Modulus of Elasticity E_s (ksf)	Shear Modulus G (ksf)	Bulk Modulus K (ksf)
95.0	58.0	434.0	33.0		288.0	192.0	115.0
90.0		533.0		0.9	430.0	478.0	159.0
85.0		649.0		1.5	937.0	1,562.0	335.0
80.0	89.0	784.0	37.0		612.0	680.0	227.0
75.0	73.0	813.0	37.0		516.0	430.0	198.0
70.0		829.0		3.2	2,313.0	2,570.0	857.0
65.0		807.0		2.2	1,466.0	1,629.0	543.0
60.0		969.0		4.2	6,287.0	20,957.0	2,168.0
55.0	87.0	1,006.0	37.0		828.0	1,380.0	296.0
50.0	90.0	1,044.0	37.0		912.0	1,520.0	326.0
40.0	96.0	1,101.0	38.0		1,068.0	1,780.0	381.0
30.0	98.0	1,163.0	40.0		1,212.0	2,020.0	433.0
20.0	95.0	1,205.0	39.0		1,212.0	2,020.0	433.0
10.0	92.0	1,233.0	39.0		1,212.0	2,020.0	433.0
0.0	91.0	1,251.0	39.0		1,212.0	2,020.0	433.0