Guidelines on Using the BC-Settlement Design Spreadsheet using SPT input data

1. Open the input data tab and enter the project relevant information in the data entry cells that include: GDOT project ID, project name, project location, boring number, and the testing date.
2. Under the input tab, fill the values of ground water table (feet), and the energy rating (%) of the conducted SPT.
3. Under the input tab, fill footing input parameters: embedment depth in (feet) which is the shallowest depth of footing embedment below final grade, typically taken as 1 ft to account for frost protection (in Georgia), footing thickness in (feet) which is taken as zero for MSE walls, layer thickness in (feet) leave as 999 feet unless depth to bedrock refusal is known to account for a thick homogeneous soil layer, modulus of elasticity of foundation material in (ksf) which can be taken as 4000 ksf for MSE walls and approximately 600,000 ksf for reinforced concrete.
4. Under the input tab, check the foundation shape and geometry, if the footing length (L) is known then fill it in the relevant cell in feet, otherwise determine if your footing is square (using L/B ratio of 1), rectangular (using 1 < L/B ratio < 10) or strip (using L/B ratio of 10 or more). If the footing width (B) is known or a specific value needs to be investigated then fill the relevant cell in feet where the specific L/B ratio for the case under study will be automatically evaluated.
5. Fill in the specific settlement values that need to be evaluated in inches.
6. If the bottom of wall footing/leveling pad/spread footing elevation is more than 5 feet below the ground elevation in your boring log, begin inputting boring log data from the elevation that corresponds to 5 feet above the bottom of wall footing/leveling pad/spread footing elevation.
7. In the input tab fill in the SPT raw readings: fill in the depth (feet) and the SPT readings, either: (a) individual blows for 6-inch increments #1, #2, and #3; or (b) the summed up $N_{measured}$ value in blows per foot.
8. Fill in each of the soil type cells with depth following the USCS classification system. The following soil types are recognized in the spreadsheet: PT, OL, OH, ML, MH, CL, CH, SW, SP, GW, GP, GM, GC, SM, SC, CL-ML, SM-ML, ML-SM, SM-MH, MH-SM, GP-GC, GP-GM, GW-GC, GW-GM, SC-SM, GC-GM, SP-SC, SP-SM, SW-SC, SC-H, SM-H, SM-SC, GM-GC, and SW-SM.
9. After providing the soil type cell according to USCS, a number of unfavorable problematic soil types will be highlighted, flagged and colored: silts, clays, organics, and peat. Any mistake in typing the soil type or any non-USCS classified soils will be flagged as "UNKNOWN".
10. Next to the soil type column check if there are any messages of "CONTACT SENIOR GEOTECH ENGINEER" which will appear in the case of organics with

low plasticity (OL), or organics with high plasticity (OH), or peat (PT), indicating the insuitability of the studied location.

11. Also check if there are any messages of "CONTACT GEOTECH ENGINEER – CHECK OCR PROFILE" which will appear in case of soft normally consolidated to lightly over consolidated clays or silts with low overconsolidation ratio values < 3. A guideline on acceptable and unacceptable OCRs is provided in Section 4.8 of this report.
12. Check the percentage of clay readings relative to the total number of readings which should be acceptable if the value is below 10% and provided that OCRs > 3.
13. After filling the raw SPT and footing data, any additional notes can be added in the "additional notes" box provided, for the particular case under study.
14. After filling the data in the input tab, the averaged geoparameters (soil unit weight, angle of internal friction, and soil modulus of elasticity) will be automatically calculated and averaged in the SPT-CALCS tab using a geometric mean function. The averaged geoparameters exclude any data at depth smaller than the embedment depth.
15. Under the Geoparameter Plots tab there will be summary plots of $N_{measured}$, N_{60}, unit weight (γ), soil modulus of elasticity (E), angle of internal friction (ϕ), and overconsolidation ratio (OCR) with a cutoff OCR value of 3 versus depth in both metric and English units.
16. Under the summary tab, there will be plots of all LRFD solutions for shallow foundations bearing capacity and settlement design charts for square, rectangular, and strip footings on granual soils.
17. Based on the type of analyses required, choose the corresponding tab for more details. In the analyses tabs, a default value of 0.2 is assigned for the Poisson's ratio of the soil (drained behavior) and of the foundation material. And since the spreadsheet is evaluating bearing capacity and settlement for granular soils then a default effective cohesion intercept (c') value of zero is assigned. All other values are automatically populated based on previously entered information.
18. For factored bearing resistance versus footing width for different settlement values use the tabs: Constant L, Square, Rectangle, or Strip. If the footing width (B) is known or a specific value is needed for investigation and filled in the input data tab, then this value will be calculated and highlighted in green in all the analyses tables.
19. The constant L tab will be used if the footing length (L) is known and filled in the input data tab. Use the square tab in case of square footings with L/B ratio = 1. For rectangular footings use the rectangle tab with the intermediate value of 1 < L/B ratio < 10. For strip footings use the strip tab that uses L/B ratio of 10 or more.

20. For a different representation of the results, there are plots in terms of factored bearing resistance versus settlement for different footing width values. Using this representation there are two options; either a footing with a constant length L for which you will use the stress-settlement for constant L tab or a square footing with L / B ratio = 1 for which you will use the stress-settlement-square tab.

Illustrated Example using SPT data

Standard Penetration Test Data		
GDOT Project ID:	Test Data Number 2	← data entry
Project Name:	Georgia LRFD Site	← data entry
Location:	Newnan	← data entry
Boring Number:	SPT-X552	← data entry
Date:	18 March 2016	← data entry

SPT procedures per ASTM D 1586

Figure B.1 *Raw SPT Input Data*

FOOTING INPUT PARAMETERS

Embedment Depth, D_f (ft) =		← data entry
Footing Thickness, t (ft) =		← data entry
Layer Thickness, h (ft) =		← data entry
Modulus of Foundation, E_{FDTN} (ksf) =		← data entry

Ground Water Table	28	feet	← data entry
Energy Rating	61	%	← data entry

Figure B.2 *Footing Input Parameters and Energy Rating*

FOUNDATION SHAPES and GEOMETRY

Footing Length L (ft) =	100	← data entry if known
Footing Width B (ft) =	8	← data entry if known
Current Case - L/B =	13	
Square - L/B =	1	
Rectangular - L/B =	5	
Strip - L/B =	10	

Figure B.3 *Foundation Shape and Geometry*

Total Number of Readings	25
Number of Clay Readings	3
% Clay Readings	12.00

Figure B.4 *Percentage of Clay Readings*

SPECIFIC SETTLEMENT VALUE (in)	
0.5	← data entry
1	← data entry
1.5	← data entry
2	← data entry
2.5	← data entry
3	← data entry
4	← data entry

Figure B.5 *Specific Settlement Values Input*

	Depth	SPT Reading	USCS	
	(feet)	N-value (bpf)	Soil Type	
	0.00			
data entry →	1.50	12	SM	
data entry →	3.00	18	SC	
data entry →	4.50	22	PT	CONTACT SENIOR GEOTECH ENGINEER
data entry →	6.00	26	MH	
data entry →	7.50	28	ML	
data entry →	9.00	15	SM-SC	
data entry →	10.50	16	SW-SC	
data entry →	12.00	17	OL	CONTACT SENIOR GEOTECH ENGINEER
data entry →	13.50	19	SM	
data entry →	15.00	22	GW	

Figure B.6 *Atlernative (a): Raw SPT Input Data: Depth, Measured N (bpf), and Soil Type*

	Raw SPT Blows Per 6 inches			
	#1	#2	#3	N-value (bpf)
data entry →	2	8	4	12
data entry →	3	9	9	18
data entry →	4	10	12	22
data entry →	5	14	12	26
data entry →	6	14	14	28
data entry →	6	8	7	15
data entry →	3	6	10	16
data entry →	4	10	7	17
data entry →	5	10	9	19
data entry →	6	12	10	22

Figure B.7 *Atlernative (b): Raw SPT Input Data: Row Field Blows per 6 inches*

Additional Notes:

Figure B.8 *Additional Notes Box*

	GEOPARAMETER	SI Units		English Units	
Average	Unit Weight	18.68	kN/m^3	0.1189	kcf
	Friction Angle ϕ	38.496	degrees	38.496	degrees
	Modulus of Elasticity	347.20	bar	725.15	ksf

Figure B.9 *Average Unit Weight, Friction Angle, and Soil Modulus of Elasticity using SPT Input Data*

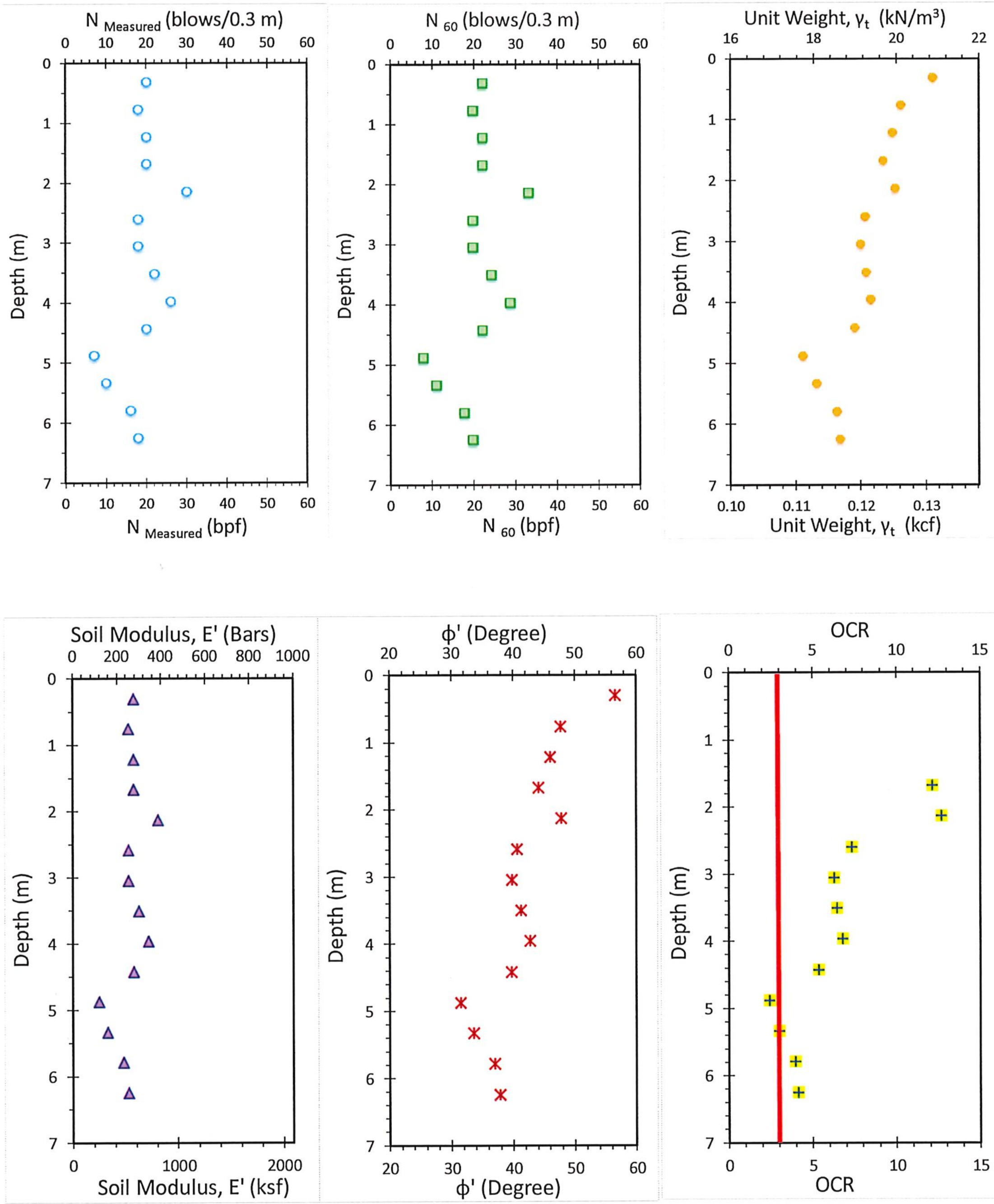

Figure B.10 *Profiles of SPT Input and Output Data*

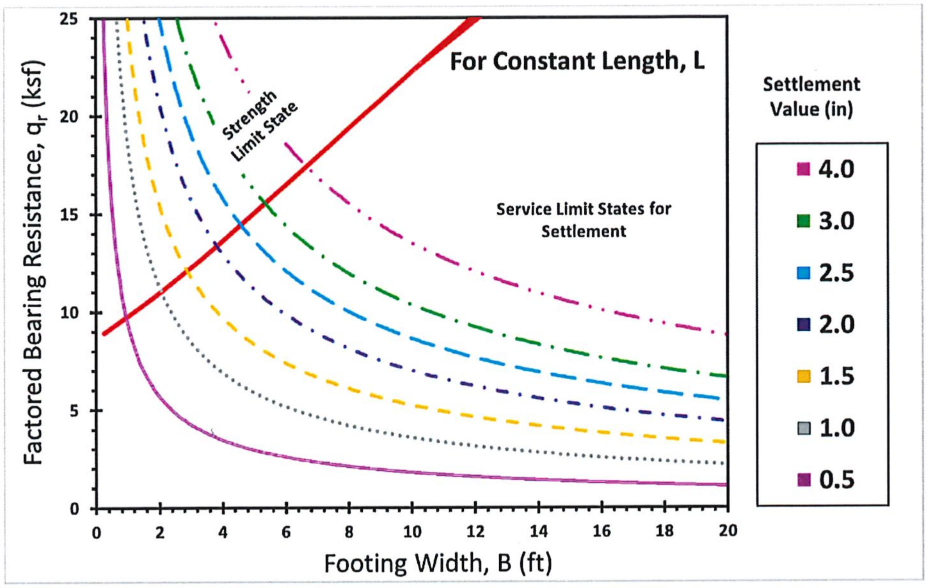

Figure B.11 *Factored BC-Footing Width Design Chart with different settlement contours for Constant L value*

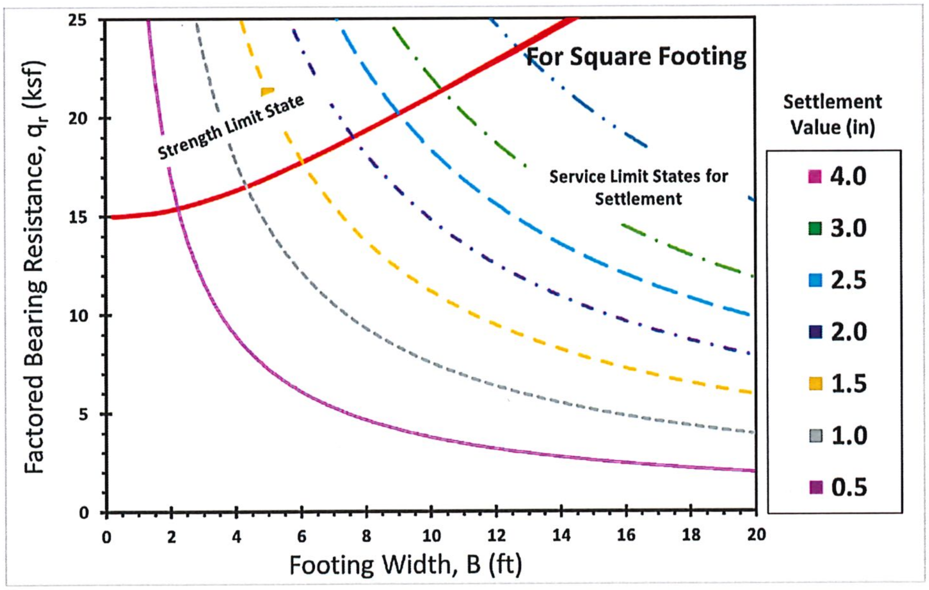

Figure B.12 *Factored BC-Footing Width Design Chart with different settlement contours for Square Footing (Constant L/B ratio = 1)*

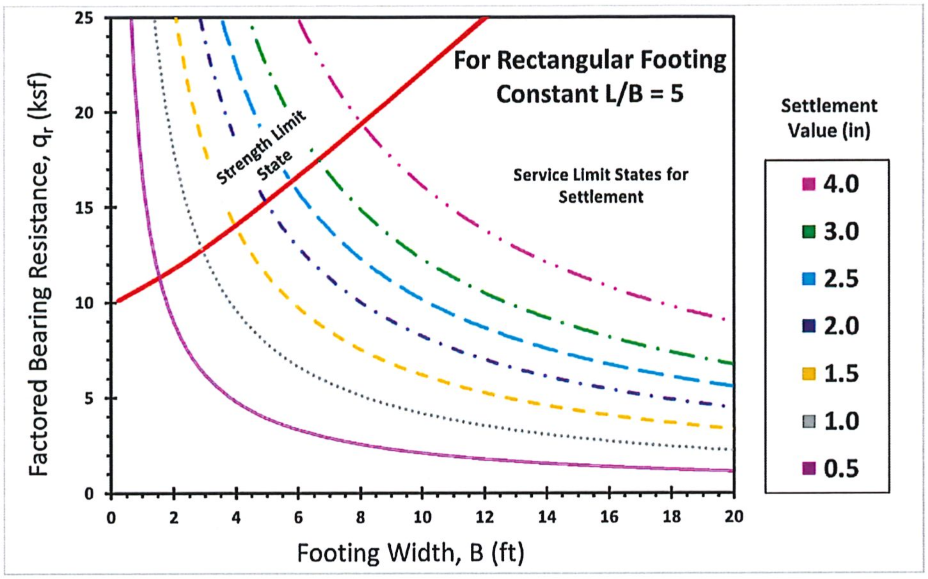

Figure B.13 *Factored BC-Footing Width Design Chart with different settlement contours for Rectangular Footing (L/B = 5)*

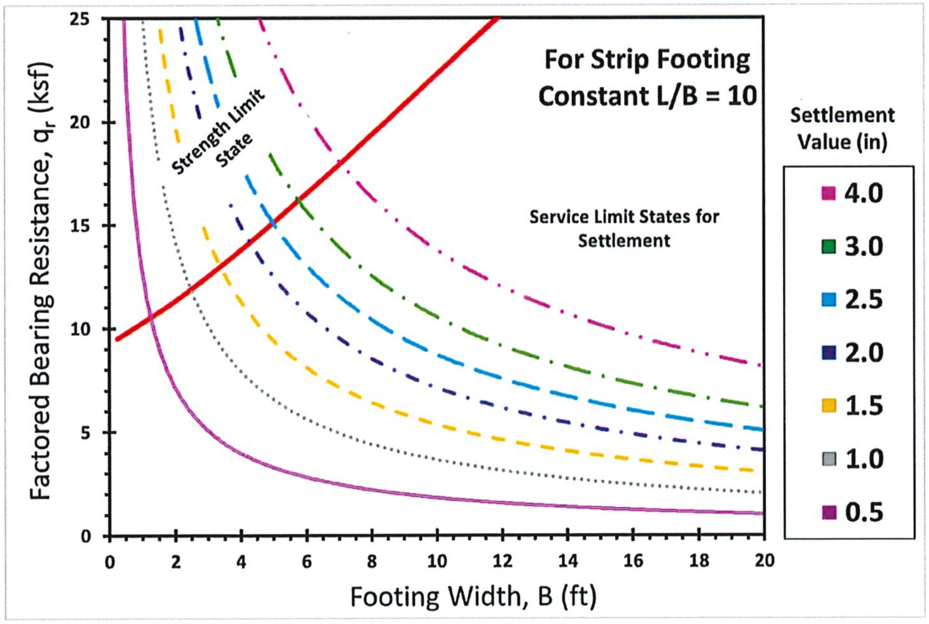

Figure B.14 *Factored BC-Footing Width Design Chart with different settlement contours for Strip Footing (L/B = 10)*

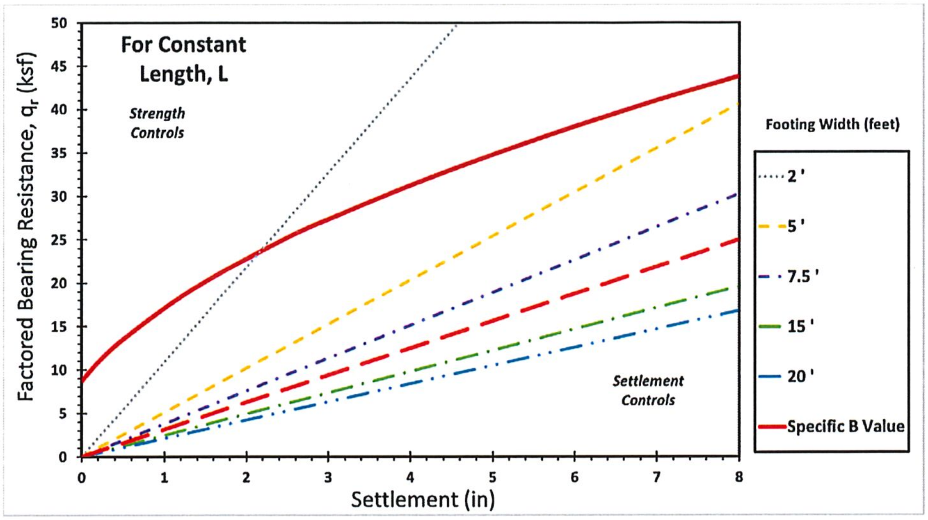

Figure B.15 *Factored BC-Settlement Design Chart with different footing width contours for footings with Constant Length*

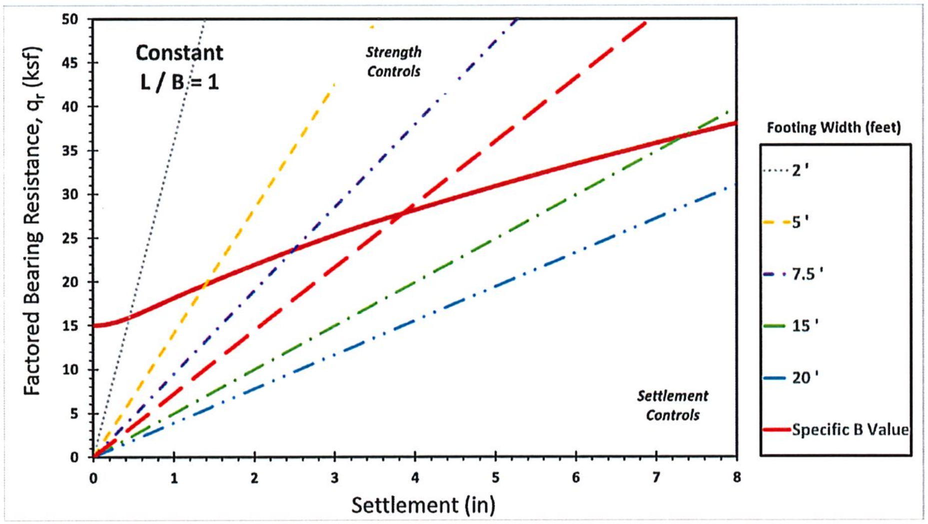

Figure B.16 *Factored BC-Settlement Design Chart with different footing width contours for Square Footing (L/B = 1)*