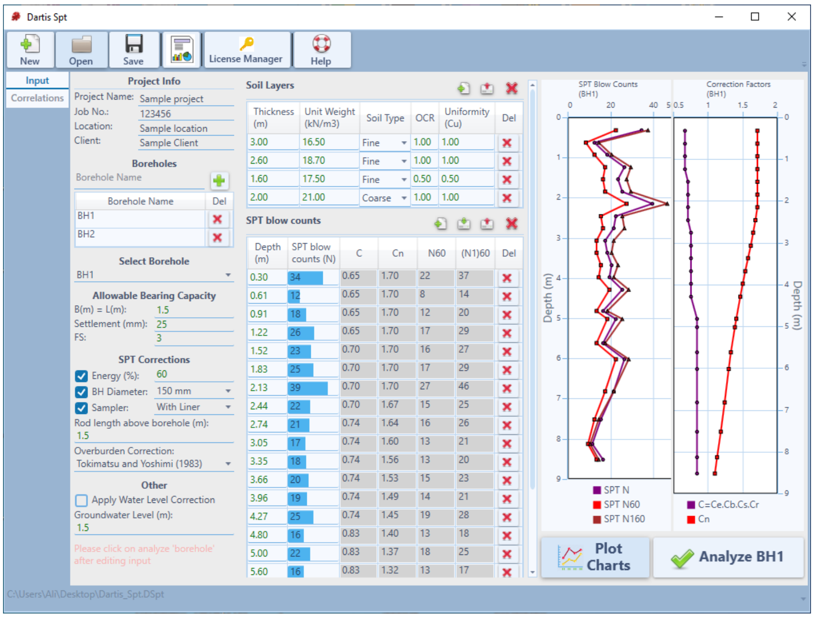


DartisSPT

User guide
2022

Table of contents

1. About

DartisSPT is a computer program for interpretation of Standard Penetration Test (SPT) and correlating blow counts (N) to soil properties based on more than 200 correlations. It provides several reporting and additional features.

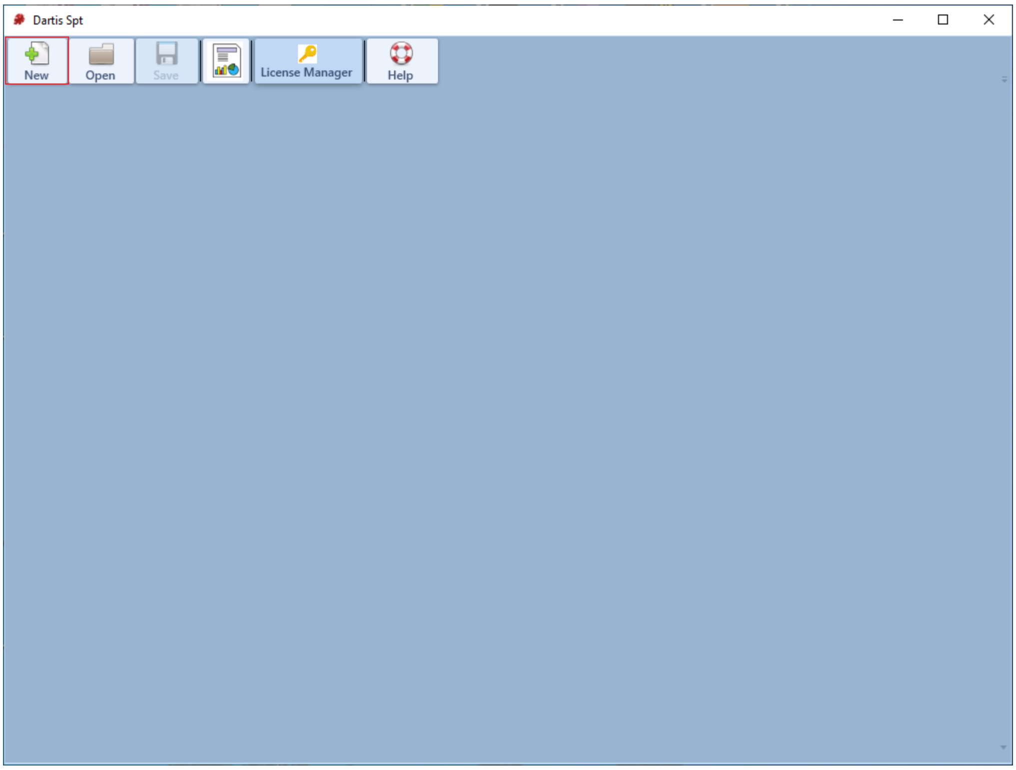
Although all efforts have been undertaken to ensure that this software is of the highest possible quality and that the results obtained are correct, the authors do not warrant the functions contained in the program will meet your requirements or that the operation of the program will be uninterrupted or error-free. The authors are not responsible and assume no liability for any results or any use made thereof, nor for any damages or litigation that may result from the use of the software for any purpose. All results to be verified independently by user.

Purchase full version	Terms & Conditions
Program's web page	Bug report / Feature request

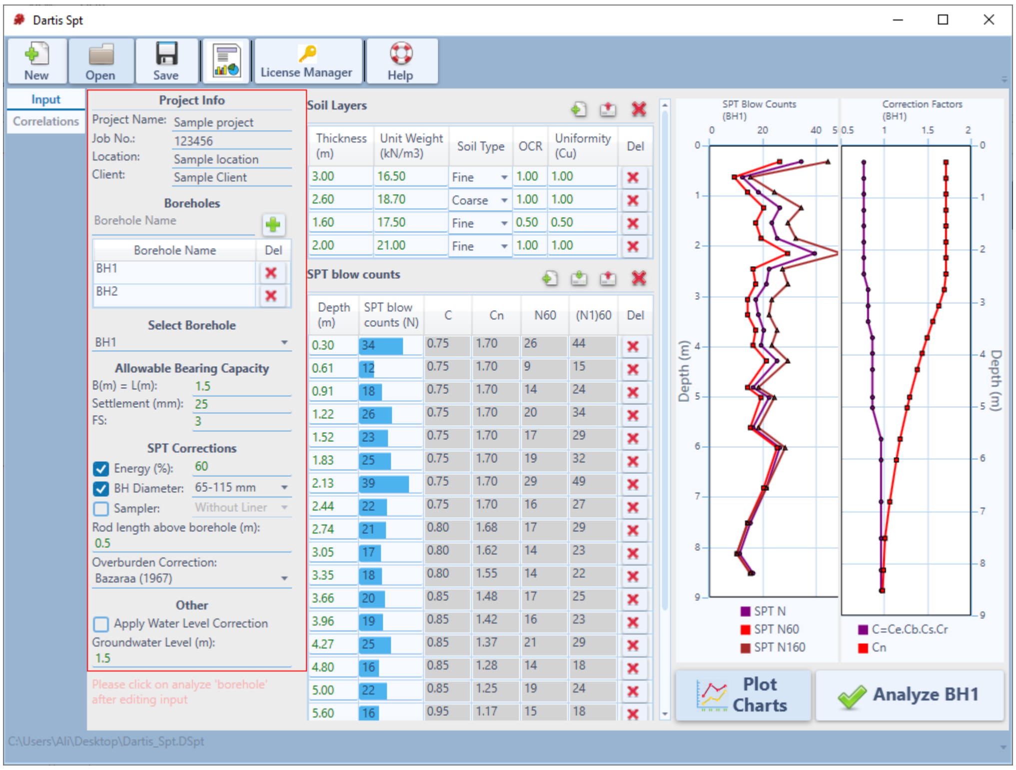
2. Geting Started

When starting a new analysis with DartisSPT, take the following steps:

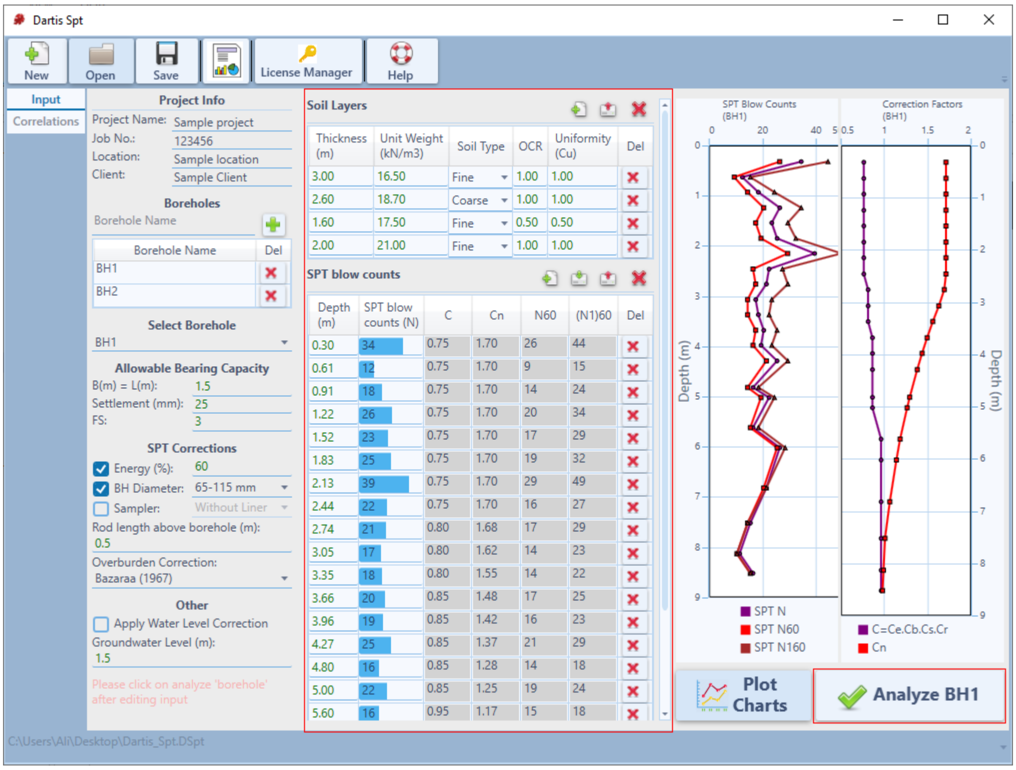
1- Create a new project: by clicking on 'New' button, a dialogue will open. Choose the location where you want the project to be saved. Files are saved with *.DSpt extension and the complete file path is shown at the bottom of the page.



2- Enter project info: Type the name of the borehole and add it to the project. Select the desired borehole from the combo box. Enter input data including allowable bearing capacity factors, correction factors and ground water level for that borehole.



3- Enter subsurface soil layers and SPT blow counts in the corresponding tables, as shown below. Notice that you can update plots on the right -hand side of the page by clicking on 'Plot Charts'. When data entry is over, click on 'Analyze borehole' button. Then you can go to 'Correlations' tab and choose the soil parameter to correlate, at the depth at which correlations are needed.



Exporting tables to Excel

Simply click on 'Save as Excel' button above each table or right click on table's header and choose 'Save as Excel' option.

3. Unit System

This version of Dartis SPT supports the following unit system:

·Metric units (kg, m, cm)

4. Formulas

SPT correlations are typically derived based on case studies or field tests in a specific soil types. As a result, most of the SPT correlations are only valid for one or two soil types. In Dartis SPT database of correlations, some correlations are applicable for Coarse-Grained soils, some correlations are applicable for Fine-Grained soils and some correlations are applicable for both Fine-Grained and Coarse-Grained soils.

Dartis SPT automatically filters available correlations based on soil grain size (e.g Coarse / Fine / Coarse and Fine).

4.1. Coarse and Fine grained soils

Includes:

- ·Overburden correction factor (Cn)
- ·Allowable Bearing Capacity

4.1.1. Overburden correction factor (Cn)

Results are adjusted: 0.4<Cn<1.7

Reference	Note	Formula
Gibbs & Holtz (1959)	Unit of effective stress psi	$Cn = \frac{50}{10+\sigma'_{V0}}$
Bazaraa (1967)	Unit of effective stress in ksf	$(\sigma'_{V0} \le 1.5) \Rightarrow Cn = (\frac{4}{1+2\sigma'_{V0}}), (\sigma'_{V0} > 1.5) \Rightarrow Cn = (\frac{4}{3.25+0.5\sigma'_{V0}})$
Peck et al. (1974)	Unit of effective stress in kg/cm2	$Cn = 0.77 log_{10}\left(\frac{20}{\sigma'_{V0}}\right)$
Seed (1976)	Unit of effective stress in kg/cm2	$Cn = 1 - 1.25 log_{10}(\sigma'_{V0})$
Tokimatsu &Yoshimi (1983)	Unit of effective stress in kg/cm2	$Cn = \frac{1.7}{(0.7+\sigma'_{V0})}$
Liao & Whitman (1986)	Unit of effective stress in kg/cm2	$Cn = (\frac{1}{\sigma'_{V0}})^{0.5}$
Skempton (1986)	Unit of effective stress in kg/cm2	$Cn = (\frac{2}{1+\sigma'_{V0}})(NCMediumLooseFineSands)$
Skempton (1986)	Unit of effective stress in kg/cm2	$Cn = (\frac{3}{2+\sigma'_{V0}})(NCDenseCoarseSand)$
Skempton (1986)	Unit of effective stress in kg/cm2	$Cn = (\frac{1.7}{0.7+\sigma'_{V0}})(OCFineSands)$

4.1.2. Allowable Bearing Capacity

Based on shear failure criteria

Reference	Note	Formula
Teng (1969)	N = Average corrected spt blow count (Gibbz and Holtz 1948) to 1B depth below footing B(m) = Footing width *(defined by user)* Df(m) = Depth of footing *(at spt test depth)* FS = Factor of safety *(defined by user)* Dw(m) = Depth of ground water level *(defined by user)*	$Qa(kPa) = 0.1570464(2N^2BR_w + 6(100 + N^2)D_fR'_w)/FS$ $Dw <= Df: R'_w = 0.5, R_w = 1 - \frac{Df - Dw}{2Df}$ $Dw > Df and Dw < (Df + B): R_w = 1, R'_w = 0.5 + \frac{Dw - Df}{2B}$ $Dw >= (Df + B): R'_w = R_w = 1$
Meyerhof Method	N = Average uncorrected spt blow count to 1.5B depth below footing B(m) = Footing width *(defined by user)* Df(m) = Depth of footing *(at spt test depth)* FS = Factor of safety *(defined by user)* Dw(m) = Depth of ground water level *(defined by user)*	$Qa(kPa) = 314.0928(NB/10(C_{w1} + C_{w2}D_f/B))/FS$ $Dw <= Df: C_{w1} = 0.5, C_{w2} = 1 - \frac{Df - Dw}{2Df}$ $Dw > Df and Dw < (Df + 1.5B): C_{w2} = 1, C_{w1} = 0.5 + \frac{Dw - Df}{3B}$ $Dw >= (Df + 1.5B): C_{w1} = C_{w2} = 1$
General Terzaghi Formula	$\overline{q}$ =effective stress at foundation level (kPa) γ =soil unit weight at foundation level (kN/m3) B(m) = Footing width *(defined by user)* FS = Factor of safety *(defined by user)* N1(60) = corrected spt blow count at foundation level	$Qa(kPa) = (\overline{q}N_q + 0.5B\gamma N_\gamma)/FS$ $Bowels(1986) \rightarrow Nq = e^{\pi \tan\varphi}.\tan^2(45 + \varphi/2)$ $Hansen(1970) \rightarrow N\gamma = 1.5(Nq - 1)\tan\varphi$ $Hatanaka(1996) \rightarrow \varphi = 3.5\sqrt{N_160} + 22.3$

Based on allowable settlement

Reference	Note	Formula
Terzaghi and Peck (1948)	N = Average uncorrected spt blow count to 1B depth below footing B(m) = Footing width *(defined by user)* Se(mm) = Allowable settlement *(defined by user)* Cw = Water depth factor Cd= Footing depth factor Dw(m) = Depth of ground water level *(defined by user)* Df(m) = Depth of footing *(at spt test depth)*	$(B <= 1.22) \Rightarrow Qa(kPa) = 0.4713\frac{NS_e}{C_wC_d}, (B > 1.22) \Rightarrow Qa(kPa) = 0.3142\frac{NS_e}{C_wC_d}\left(\frac{3.28B + 1}{3.28B}\right)^2$ surface footing: $Cd = 1, 1 \leq Cw = 2 - \frac{Dw}{B} \leq 2$ not surface footing: $Dw <= Df: 1 \leq Cw = 2 - 0.5\frac{Df}{B} <= 2$ $Dw > Df: Cw = 1$ $0.75 \leq Cd = 1 - 0.25\frac{Df}{B} \leq 1$
Modified Meyerhof (1965)	N = Average uncorrected spt blow count to 1B depth below footing B(m) = Footing width *(defined by user)* Se(mm) = Allowable settlement *(defined by user)* Cd= Footing depth factor Df(m) = Depth of footing *(at spt test depth)*	$(B <= 1.22) \Rightarrow Qa(kPa) = 0.9426NS_eC_d, (B > 1.22) \Rightarrow Qa(kPa) = 0.6283NS_eC_d\left(\frac{3.28B + 1}{3.28B}\right)^2$ $Cd = 1 + 0.33\frac{Df}{B} \leq 1.33$
Anagnotopoulos et al. (1991)	N = Average uncorrected spt blow count to 1B depth below footing B(m) = Footing width *(defined by user)* S(mm) = Allowable settlement *(defined by user)*	$Qa(kPa) = \left(\frac{SN^{1.2}}{2.37B^{0.7}}\right)^{1/0.87}$
Burland and Burbidge (1985)	N = Average corrected spt blow count to 1.4*Br*(B/Br)^0.75 depth below footing Br = Refrence footing width = 0.3m B(m) = Footing width *(defined by user)* S(mm) = Allowable settlement *(defined by user)*	$Qa(kPa) = \frac{SN^{1.4}}{1.706B^{0.7}}$

4.2. Coarse grained soils

Includes:

- ·Relative Density (Dr)
- ·Friction Angle (Phi)
- ·Elastic Modulus (Es)
- ·Shear Wave Velocity (Vs)
- ·Shear Modulus (Gmax)

4.2.1. Relative Density (Dr)

Results are adjusted: 0<Dr<100

Reference	Note	Formula
Marcuson & Beiganousky (1977a)	Fine sand effective stress in psi	$Dr = 8.6 + 0.83((N + 10.4 - 3.2OCR - 0.24\sigma'_{V0})/0.0045)^{0.5}$
Marcuson & Beiganousky (1977b)	Coarse sand effective stress in psi	$Dr = 12.2 + 0.75(222N + 2311 - 711OCR - 53\sigma'_{V0} - 50Cu^2)^{0.5}$
Marcuson (1978)	NC effective stress in psi	$Dr = 11.7 + 0.76(222N + 1600 - 53\sigma'_{V0} - 50Cu^2)^{0.5}$
Borowczyk & Frankowski (1981)		$Dr = 100(0.118 + 0.44logN)$
Borowczyk & Frankowski (1981)	Effective stress in tons/m2	$Dr = 100\frac{(N)^{0.5}}{4.188 + 0.639(\sigma'_{V0})^{0.606}}$
Tokimatsu & Yoshimi (1983)	Clean sands Effective stress in kg/cm2	$Dr = 16(N_1)^{0.5}, Cn = \frac{1.7}{0.7 + \sigma'_{V0}}$
Skempton (1986)	Dr > 35	$Dr = 100((N_1)60/60)^{0.5}$
Skempton (1986)	0.5< Effective stress <1.5 kg/cm2, 40<Dr<90	$Dr = 100(N/(17 + 22\sigma'_{V0}))^{0.5}$
Yoshida et al. (1988)	Fine Sand Effective stress in kPa	$Dr = 22(N)^{0.57} * (\sigma'_{V0})^{-0.14}$
Yoshida et al. (1988)	Gravel Content 25% Effective stress in kPa	$Dr = 18(N)^{0.57} * (\sigma'_{V0})^{-0.14}$
Yoshida et al. (1988)	Gravel Content 50% Effective stress in kPa	$Dr = 25(N)^{0.44} * (\sigma'_{V0})^{-0.13}$
Yoshida et al. (1988)	All soils Effective stress in kPa	$Dr = 25(N)^{0.46} * (\sigma'_{V0})^{-0.12}$
Kulhawy & Mayne (1990)	Normally consolidated, unaged sands	$Dr = 100((N_1)60/60)^{0.5}$
Hatanaka & Feng (2006)	N1 = N(98/σ')0.5 ,σ' in kPa	$0 \le N1 \le 25 \Rightarrow Dr = 1.55N1 + 40, 25 < N1 < 50 \Rightarrow Dr = 0.84N1 + 57.8$

4.2.2. Friction Angle (Phi)

Results are adjusted: 0<phi<45

Reference	Note	Formula
Meyerhof (1956)		$\phi' = (10N)/35 + 27^{\circ}$
Kishida (1967)		$\phi' = (20N)^{0.5} + 27^{\circ}$
Muromachi et al. (1974)		$\phi' = 3.5(N)^{0.5} + 20^{\circ}$
Muromachi et al. (1974)	Effective stress in MN/m2	$\phi' = (N/\sigma'_{v0})^{0.5} + 26.9^{\circ}$
Shioi & Fukui (1982)		$\phi' = (15N)^{0.5} + 15^{\circ}$
Kulhawy & Mayne (1990)		$\phi' = (15.4(N_1)_{60})^{0.5} + 20^{\circ}$
Bergado et al. (1993)		$\phi' = (12N)^{0.5} + 23.7^{\circ}$
Hatanaka & Uchida (1996)		$\phi' = 3.5((N_1)_{60})^{0.5} + 22.3^{\circ}$
Duncan (2004)	Gravel, Cu>4 Dr based on Kulhawy & Mayne(1990) Effective stress in kPa	$\phi' = 44 + (10Dr)/100 - (7 + 2Dr/100)*Log(\sigma'_{v0}/100)$
Duncan (2004)	Sand, Cu<6 Dr based on Kulhawy & Mayne(1990) Effective stress in kPa	$\phi' = 34 + (10Dr)/100 - (3 + 2Dr/100)*Log(\sigma'_{v0}/100)$
Duncan (2004)	Sand, Cu>6 Dr based on Kulhawy & Mayne(1990) Effective stress in kPa	$\phi' = 39 + (10Dr)/100 - (3 + 2Dr/100)*Log(\sigma'_{v0}/100)$
Hettiarachchi & Brown (2009)	Loose sand Effective stress in kPa	$\phi' = 0.383tan^{-1}((0.2N60)/(\sigma'_{v0}/100) - 0.68)*180/\pi$
Hettiarachchi & Brown (2009)	Dense sand Effective stress in kPa	$\phi' = 0.383tan^{-1}((0.2N60)/((0.5\sigma'_{v0})/100) - 0.68*0.25)*180/\pi$
Schmertmann (1975)	Effective stress in kPa	$\phi' = tan^{-1}(N_{60}/(12.2 + \frac{20.3*\sigma'_{v0}}{100}))^{0.34}*180/\pi$
Shioi and Fukui (1954)	General case	$\phi' = 20 + 0.45*N_{70}$
Shioi and Fukui (1954)	For roads and bridges	$\phi' = 15 + (18*N_{70})^{0.5}$
Shioi and Fukui (1954)	For buildings	$\phi' = 27 + 0.36*N_{70}$
Terzaghi, Peck and Mesri (1996)	Fine-grained sands	$\phi' = 20 + N_{60}/3$
Terzaghi, Peck and Mesri (1996)	Coarse-grained sands	$\phi' = 20 + N_{60}/4$

4.2.3. Elastic Modulus (Es)

Reference	Note	Formula
Webb (1969)	Sand	$E_s(MPa) = 0.1072517801*5(N+15)$
Webb (1969)	Clayey sand	$E_s(MPa) = 0.1072517801*10/3(N+5)$
Denver (1982)	Sand	$E_s(MPa) = 7*(N)^{0.5}$
Wrench & Nowatzki (1986)	Partially saturated gravels	$E_s(MPa) = 2.22N^{0.888}$
Bowles (1988)	Gravelly sand and gravel	$E_s(MPa) = 1.2(N+6)$
Bowles (1988)	Clayey sand	$E_s(MPa) = 0.32(N+15)$
Bowles (1988)	Silty sand	$E_s(MPa) = 0.3(N+6)$
Jones & Rust (1989)	Residual	$E_s(MPa) = 1.6N$
Papadopoulos (1992)	Sand	$E_s(MPa) = 7.5 + 0.8N$
Decourt (1994)	Saprolite	$E_s(MPa) = 2.5N_{60}$
AASHTO (1996)	Clean fine to medium sands and slightly silty sands	$E_s(MPa) = 700/1000N1_{60}$
AASHTO (1996)	Coarse sands and sands with little gravel	$E_s(MPa) = 1000/1000N1_{60}$
AASHTO (1996)	Sandy gravels	$E_s(MPa) = 1200/1000N1_{60}$
Chaplin (1963)	Sand	$E_s(MPa) = (44N_{60})^{0.75}*95.76/1000$
D'Appolonia et al (1970)	Sand (normally consolidated)	$E_s(MPa) = (220 + 11N1_{60})*100/1000$
Farrent (1963)		$E_s(MPa) = (7.5*8/9*N_{60}*95.76)/1000$
Kulhawy and Mayne (1990)	Sands with fines	$E_s(MPa) = (5*100*N_{60})/1000$
Kulhawy and Mayne (1990)	Clean sands (normally consolidated)	$E_s(MPa) = (10*100*N_{60})/1000$
Kulhawy and Mayne (1990)	Clean sands (over consolidated)	$E_s(MPa) = (15*100*N_{60})/1000$
Mezenbach (1961)	Fine-grained sand (above water level)	$E_s(MPa) = 100(52 + 3.3N_{60})/1000$
Mezenbach (1961)	Fine-grained sand (below water level)	$E_s(MPa) = 100(71 + 4.9N_{60})/1000$
Mezenbach (1961)	Sand (medium)	$E_s(MPa) = 100(39 + 4.5N_{60})/1000$
Mezenbach (1961)	Coarse-grained sand	$E_s(MPa) = 100(38 + 10.5N_{60})/1000$
Mezenbach (1961)	Sand and gravel	$E_s(MPa) = 100(43 + 11.8N_{60})/1000$
Mezenbach (1961)	Silty sand	$E_s(MPa) = 100(21 + 5.3N_{60})/1000$
Schultze and Muhs (1967)	Sand	$E_s(MPa) = 0.1*(0.00231839(N1_{60})^3 - 0.489236(N1_{60})^2 + 34.619(N1_{60}) + 2.78904)$

4.2.4. Shear Wave Velocity (Vs)

Reference	Note	Formula
Imai (1977)	Alluvial sand	$Vs(m/s) = 80.6(N)^{0.331}$
Imai (1977)	Dilluvial sand	$Vs(m/s) = 97.2(N)^{0.323}$
Imai (1977)	All	$Vs(m/s) = 91(N)^{0.337}$
Schmertmann (1978)	Fine sands above water table	$Vs(m/s) = 15(N)$
Ohta & Goto (1978)	All	$Vs(m/s) = 85(N)^{0.341}$
Ohta & Goto (1978)	Sands	$Vs(m/s) = 88(N)^{0.340}$
Ohta & Goto (1978)	Gravels	$Vs(m/s) = 75.3(N)^{0.351}$
Ohta & Goto (1978)	Clays	$Vs(m/s) = 87(N)^{0.360}$
Imai & Tonouchi (1982)	All	$Vs(m/s) = 97(N)^{0.314}$
Seed et al. (1983)	Sands	$Vs(m/s) = 56(N)^{0.5}$
Sykora & Stokoe (1983)	Granular	$Vs(m/s) = 107(N)^{0.34}$
Seed et al. (1985)	Sands & silty sands	$Vs(m/s) = 61(N1)^{0.5}$
Towhata & Ronteix (1988)	Alluvial sand	$Vs(m/s) = 80(N)^{0.33}$
Jamiolkowski et al. (1988)	Holocene fine sand	$Vs(m/s) = 53.5(N60)^{0.17}(Z)^{0.193}f_A f_G (f_A = 1)(f_G = 1.09)$
Jamiolkowski et al. (1988)	Holocene Medium sand	$Vs(m/s) = 53.5(N60)^{0.17}(Z)^{0.193}f_A f_G (f_A = 1)(f_G = 1.07)$
Jamiolkowski et al. (1988)	Holocene coarse sand	$Vs(m/s) = 53.5(N60)^{0.17}(Z)^{0.193}f_A f_G (f_A = 1)(f_G = 1.14)$
Jamiolkowski et al. (1988)	Holocene sand and gravel	$Vs(m/s) = 53.5(N60)^{0.17}(Z)^{0.193}f_A f_G (f_A = 1)(f_G = 1.45)$
Jamiolkowski et al. (1988)	Holocene gravel	$Vs(m/s) = 53.5(N60)^{0.17}(Z)^{0.193}f_A f_G (f_A = 1)(f_G = 1.45)$
Jamiolkowski et al. (1988)	Pleistocene fine sand	$Vs(m/s) = 53.5(N60)^{0.17}(Z)^{0.193}f_A f_G (f_A = 1.3)(f_G = 1.09)$
Jamiolkowski et al. (1988)	Pleistocene Medium sand	$Vs(m/s) = 53.5(N60)^{0.17}(Z)^{0.193}f_A f_G (f_A = 1.3)(f_G = 1.07)$
Jamiolkowski et al. (1988)	Pleistocene cene coarse sand	$Vs(m/s) = 53.5(N60)^{0.17}(Z)^{0.193}f_A f_G (f_A = 1.3)(f_G = 1.14)$
Jamiolkowski et al. (1988)	Pleistocene sand and gravel	$Vs(m/s) = 53.5(N60)^{0.17}(Z)^{0.193}f_A f_G (f_A = 1.3)(f_G = 1.45)$
Jamiolkowski et al. (1988)	Pleistocene gravel	$Vs(m/s) = 53.5(N60)^{0.17}(Z)^{0.193}f_A f_G (f_A = 1.3)(f_G = 1.45)$
Yoshida et al. (1988)	Fine sand Effective stress in kPa	$Vs(m/s) = 49(N_1)^{0.25}(\sigma'_{v0})^{-0.14}$
Yoshida et al. (1988)	Gravel content 25% Effective stress in kPa	$Vs(m/s) = 56(N_1)^{0.25}(\sigma'_{v0})^{-0.14}$
Yoshida et al. (1988)	Gravel content 35% Effective stress in kPa	$Vs(m/s) = 60(N_1)^{0.25}(\sigma'_{v0})^{-0.14}$
Yoshida et al. (1988)	All Effective stress in kPa	$Vs(m/s) = 55(N_1)^{0.25}(\sigma'_{v0})^{-0.14}$
Lee (1992)	Sandy soils	$Vs(m/s) = 104.7(N)^{0.258}$
Kalteziotis et al. (1992)	Noncohesive Greece	$Vs(m/s) = 49.1(N)^{0.501}$
Veijayaratnam et al. (1993)	Misc. soils from Singapore	$Vs(m/s) = 90(N)^{0.34}$
Raptakis et al. (1994)	Loose sands and silts	$Vs(m/s) = 123(N_{sp})^{0.290}$
Raptakis et al. (1994)	Medium and dense Sands	$Vs(m/s) = 100(N_{sp})^{0.247}$
Raptakis et al. (1994)	Gravelly soil mixtures	$Vs(m/s) = 192(N_{sp})^{0.191}$
Athanasopoulos (1994)	Gravelly soils	$Vs(m/s) = 65.3(N)^{0.42}$
Akino & Sahara (1994)	Sand and rock	$Vs(m/s) = 55.6(N)^{0.5}$
Pitilakis et al. (1998)	Silts and sands	$Vs(m/s) = 145(N_{sp})^{0.178}$
Rollins et al. (1998)	Holocene gravels	$Vs(m/s) = 63(N_{60})^{0.43}$
Rollins et al. (1998)	Pleistocene gravels	$Vs(m/s) = 132(N_{60})^{0.32}$
Rollins et al. (1998)	Holocene gravels Effective stress in kPa	$Vs(m/s) = 53(N_{60})^{0.19}(\sigma'_{v0})^{0.18}$
Rollins et al. (1998)	Pleistocene gravels Effective stress in kPa	$Vs(m/s) = 115(N_{60})^{0.17}(\sigma'_{v0})^{0.12}$
Hasancebi & Ulusay (2007)	Sands	$Vs(m/s) = 131(N_{60})^{0.205}$
Dikmen (2009)	Sands	$Vs(m/s) = 73(N)^{0.33}$
Uma Maheswari et al. (2010)	Sands	$Vs(m/s) = 100.5(N)^{0.265}$
Esfehanizadeh et al. (2015)	Sands	$Vs(m/s) = 107.2(N)^{0.34}$
Fatehnia et al. (2015)	Sands	$Vs(m/s) = 77.1(N)^{0.355}$
Kirar et al. (2016)	Sandy	$Vs(m/s) = 100.3(N)^{0.338}$
Gautam (2017)	Sand	$Vs(m/s) = 78.7(N)^{0.33}$

4.2.5. Shear Modulus (Gmax)

Reference	Note	Formula
Ohsaki & Iwasaki (1973)	All	$Gmax(MPa) = 11.5(N)^{0.78}$
Ohsaki & Iwasaki (1973)	Cohesionless	$Gmax(MPa) = 6.1(N)^{0.94}$
Imai (1977)	Alluvial sand	$Gmax(MPa) = 9.4(N)^{0.715}$
Imai (1977)	Diluvial sand	$Gmax(MPa) = 17(N)^{0.650}$
Imai (1977)	All	$Gmax(MPa) = 12(N)^{0.737}$
Imai & Tonouchi (1982)	All	$Gmax(MPa) = 14(N)^{0.68}$
Seed et al. (1983)	Sands	$Gmax(MPa) = 6.2(N)$
Stroud (1989)	Data from Imai & Tonouchi(1982)	$Gmax(MPa) = 7(N)$
Decourt (1994)	Lateritic soils	$Gmax(MPa) = 47.5(N)^{0.72}$
Hirayama (1994)	Misc. soils	$Gmax(MPa) = 5(N)$
Pinto & Abramento (1997)	Gneissic residual soil	$Gmax(MPa) = 62.8(N)^{0.30}$
Barros & Pinto (1997)	Lateritic soils	$Gmax(MPa) = 55.2(N)^{0.665}$
Barros & Pinto (1997)	Saprolitic soils	$Gmax(MPa) = 56 + 2.3(N)$
Barros & Pinto (1997)		$Gmax(MPa) = 43.8(N)^{0.419}$
Barros & Pinto (1997)		$Gmax(MPa) = 94 + 2.3(N)$
Viana da Fonseca et al. (1998)	Granitic saprolite	$Gmax(MPa) = 98 + 0.42(N_{60})$
Viana da Fonseca et al. (1998)		$Gmax(MPa) = 57(N)^{0.20}$
Anbazhagan & Sitharam (2010)	Mixed soils	$Gmax(MPa) = 24.3(N)^{0.55}$
Anbazhagan & Sitharam (2010)		$Gmax(MPa) = 29.2(N_1)_{60}^{0.57}$
Anbazhagan et al. (2012)	All soils	$Gmax(MPa) = 15.1(N_1)_{60}^{0.74}$

4.3. Fine grained soils

Includes:

- ·Undrained Shear Strength (su)
- ·Unconfined Compressive Strength (qu)
- ·Pressuremeter Modulus (Ep)
- ·Elastic Modulus (Vs)
- ·Shear Modulus (Gmax)

4.3.1. Undrained Shear Strength (su)

Reference	Note	Formula
Hara et al. (1974)	Japanese cohesive soils	$Su(kPa) = 29(N)^{0.72}$
Reese et al. (1976)	Stiff clays in Houston	$Su(kPa) = (N/15)*95.76$
Tavares (1988)	Guabirotuba clay	$Su(kPa) = 7N, N > 10 and N < 20$
Tavares (1988)	Guabirotuba clay	$Su(kPa) = 6N, N > 20 and N < 30$
Tavares (1988)	Guabirotuba clay	$Su(kPa) = 5N, N > 30 and N < 40$
Ajayi & Balogun (1988)	Tropical soil	$Su(kPa) = 1.39N + 74.2$
Decourt (1989)	Sao paulo Over-consolidated clay	$Su(kPa) = 12.5N$
Decourt (1989)	Sao paulo Over-consolidated clay	$Su(kPa) = 15N_{60}$
Nevels & Laguros (1993)	Clay and soft shale	$Su(kPa) = (0.059*N + 0.2)*107.25$
Sivrikaya & Togrol (2006)	Clays – Turkey (CH)	$Su(kPa) = 7.8N_{60}$
Sivrikaya & Togrol (2006)	Clays – Turkey (CL)	$Su(kPa) = 5.35N_{60}$
Nassaji & Kalantari (2011)	Iran clay	$Su(kPa) = 2.1N_{60} + 17.6$
Cangir & Dipova (2017)	Silty clays – Turkey	$Su(kPa) = 6.932N_{70}$
Balachandran et al. (2017)	Stiff glacial till in Canada	$Su(kPa) = 8.32N_{60}$
White et al. (2019)	London Clay	$Su(kPa) = 5.7N$

4.3.2. Unconfined Compressive Strength (qu)

Reference	Note	Formula
Terzaghi & Peck (1967)	Fine-grained	$q_u(kPa) = 12.5N$
Golder (1961)	Clay	$q_u(kPa) = (N/8)*107.25$
Sanglerat (1972)	Clay	$q_u(kPa) = 25N$
Sanglerat (1972)	Silty clay	$q_u(kPa) = 20N$
Sowers (1979)	Highly plastic clay	$q_u(kPa) = 25N$
Sowers (1979)	Medium plastic clay	$q_u(kPa) = 15N$
Sowers (1979)	Low plasticity clay	$q_u(kPa) = 7.5N$
Nixon (1982)	Clay	$q_u(kPa) = 24N$
Sarac & Popovic (1982)	Clay	$q_u(kPa) = 62.5(N - 3.4)$
Sambhandharaksa & Pitupakorn (1985)	CH Bangkok clay	$q_u(kPa) = (1.37N)*9.81$
Sambhandharaksa & Pitupakorn (1985)	CL Bangkok clay	$q_u(kPa) = (1.04N)*9.81$
Behpoor & Ghahramani (1989)	CL and CL-ML	$q_u(kPa) = 15N$
Kulhawy & Mayne (1990)	Fine-grained	$q_u(kPa) = 58N^{0.72}$
Serajuddin & Chowdhury (1996)	Bangladesh clays (LL<=35)	$q_u(kPa) = 14.3N$
Serajuddin & Chowdhury (1996)	Bangladesh clays (36<LL<50)	$q_u(kPa) = 16.9N$
Serajuddin & Chowdhury (1996)	Bangladesh clays (LL>50)	$q_u(kPa) = 17.8N$
Sivrikaya & Togrol (2002)	CH	$q_u(kPa) = 13.6N_{60}$
Sivrikaya & Togrol (2002)	CL	$q_u(kPa) = 9.8N_{60}$
Sivrikaya & Togrol (2002)	Fine-grained	$q_u(kPa) = 8.6N_{60}$

4.3.3. Pressuremeter Modulus (Ep)

Reference	Note	Formula
Nayak (1979)	Clay	$E_p(kg/cm2) = 7.7N$
Ohya et al. (1982)	Clayey soil	$E_p(kg/cm2) = 15N$
Jones & Rust (1989)	Residual soil	$E_p(kg/cm2) = (1.6N)*10.197$
Yagiz et al. (2008)	Sandy silty clay	$E_p(kg/cm2) = (388.7N + 4554)*0.010197$
Bozbey & Togrol (2010)	Clayey soils – Istanbul	$E_p(kg/cm2) = (1.61(N_{60})^{0.71})*10.197$
Kayabasi (2012)	Clayey soils – Turkey	$E_p(kg/cm2) = (0.285(N_{60})^{1.4})*10.197$
Agan & Algin (2014)	Clayey soils – Turkey	$E_p(kg/cm2) = (2.22 + 0.0029(N_{60})^{2.5})*10.197$

4.3.4. Elastic Modulus (Vs)

Reference	Note	Formula
Jinan (1985)	Shanghai	$V_s(m/s) = 121(N + 0.27)^{0.22}$
Lee (1992)	Taipei basin (D = depth in meters)	$V_s(m/s) = 84.5(N)^{0.22}(D + 1)^{0.246}$
Kalteziotis et al. (1992)	Cohesive Greece	$V_s(m/s) = 76.5(N)^{0.445}$
Pitilakis et al. (1999)	Silts	$V_s(m/s) = 145(N)^{0.178}$
Pitilakis et al. (1999)	Clays	$V_s(m/s) = 132(N)^{0.271}$
Jafari et al. (2002)	Silts	$V_s(m/s) = 22(N)^{0.770}$
Jafari et al. (2002)	Clays	$V_s(m/s) = 27(N)^{0.730}$
Hasancebi & Ulusay (2007)	Clays	$V_s(m/s) = 107.69(N_{60})^{0.237}$
Dikmen (2009)	Clay	$V_s(m/s) = 44(N)^{0.480}$
Dikmen (2009)	Silt	$V_s(m/s) = 60(N)^{0.360}$
Uma Maheswari et al. (2010)	Clay	$V_s(m/s) = 89.3(N)^{0.358}$
Tsiambaos & Sabatakakis (2011)	Clay	$V_s(m/s) = 112.2(N_{60})^{0.324}$
Tsiambaos & Sabatakakis (2011)	Silt	$V_s(m/s) = 88.8(N_{60})^{0.370}$
Fatehnia et al. (2015)	Clay	$V_s(m/s) = 77.1(N)^{0.355}$
Kirar et al. (2016)	Clay	$V_s(m/s) = 77.1(N)^{0.355}$

4.3.5. Shear Modulus (Gmax)

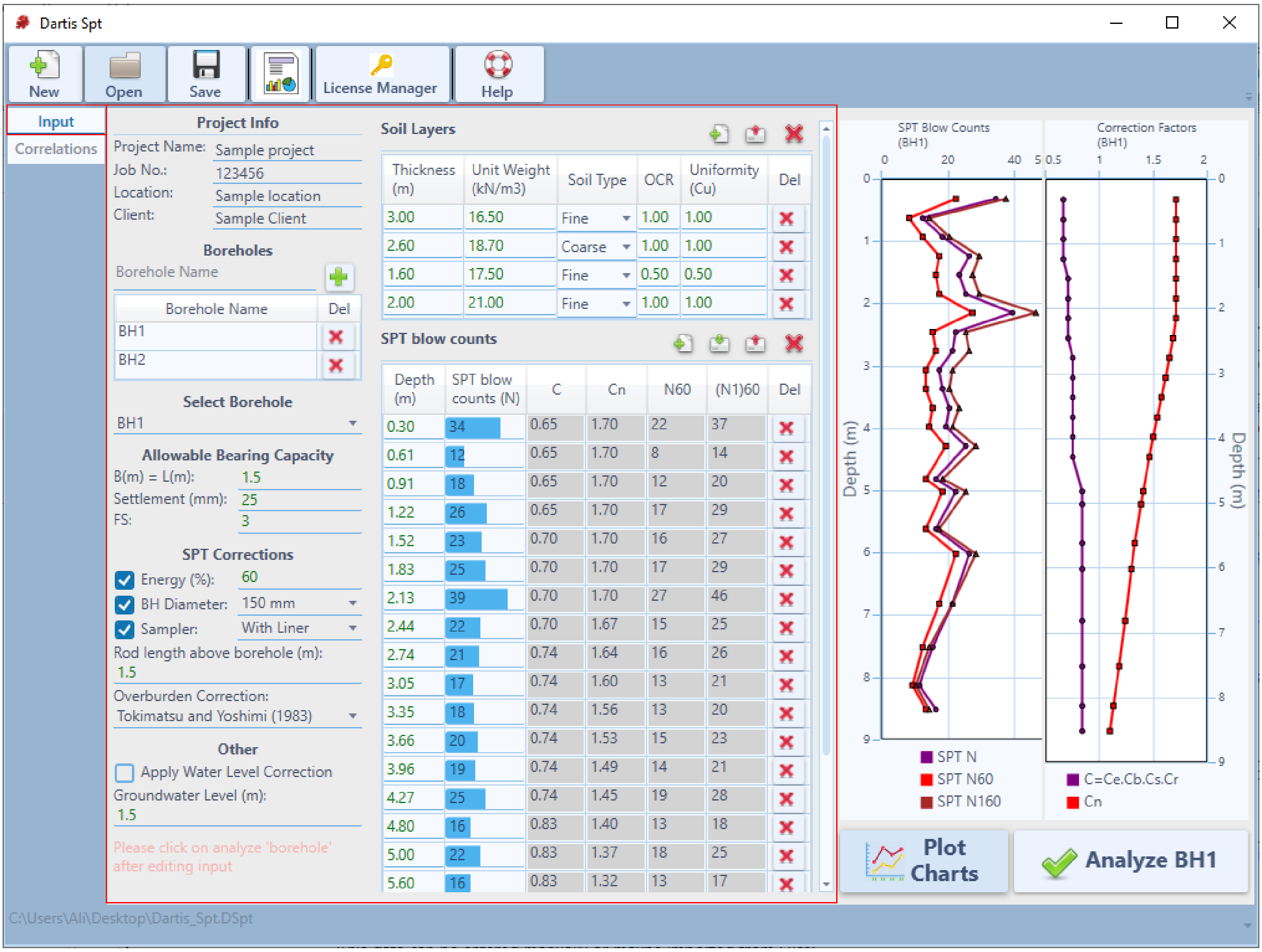
Reference	Note	Formula
Ohsaki & Iwasaki (1973)	Clay	$G_{max}(MPa) = 14(N)^{0.722}$
Hara et al. (1974)	Clay	$G_{max}(MPa) = 15.8(N)^{0.668}$
Ohba and Toriumi (1970)	Alluvial sand and clay	$G_{max}(MPa) = 13.73(N)^{0.71}$
Imai and Tonouchi (1982)	Diluvial clay	$G_{max}(MPa) = 24.61(N)^{0.555}$
Imai and Tonouchi (1982)	Alluvial clay	$G_{max}(MPa) = 17.26(N)^{0.607}$

5. Content

Includes:

5.1. Data Entry

All data entry in Dartis SPT is performed in Input tab.



This data can be categorized into the following groups:

Project Info: Simply enter project's information in this section. This information presents in reports.

Boreholes: Type the name of the borehole and add it to the project. Select the desired borehole from the combo box. Rest of input data will be applied to the currently selected borehole.

Allowable Bearing Capacity: This data is used for calculating bearing capacity of shallow footings based on shear failure or settlement criteria (based on method). Footing size and allowable footing settlement as well as safety factor against shear failure should be specified. Please notice that depth of footing (Df) is considered to be the depth (Z) selected by user on SPT table.

SPT Corrections: The following corrections should be applied on SPT number (N) to obtain N60 and N1(60) numbers:

- ·Energy level: this will adjust the SPT equipment energy to standard 60% energy. This correction factor is named Ce in Dartis SPT.
- ·Borehole diameter: size of the borehole affects the SPT blow counts. This correction factor is named Cb in Dartis SPT.
- ·Sampling method: some SPT samplers have a liner. This will affect the SPT blow counts and its correction factor is called Cs in Dartis SPT.
- ·Rod length: this correction factor is called Cr and depends on length of SPT rods which is approximately equal to the depth of the test. Dartis SPT Adds rod length

above borehole (entered by user) to the total test depth when calculating Cr: If $L < 4$ m ⇒ Cr=0.7, If $4 \text{ m} < L < 6$ m ⇒ Cr=0.85, If $6 \text{ m} < L < 10$ m ⇒ Cr=0.95, If $L > 10$ m ⇒ Cr=1.0

• ·Overburden stress: this corrections is usually called as "depth correction factor" or Cn and depends on overburden stress due to soil, at the test depth.

Please choose your favorite method for each correction factor. The following formula is used to calculate the correction factors at each depth:

C=Ce.Cb.Cs.Cr N60=C.N N1(60)=Cn.N60

All the above-mentioned factors as well as N60 and N1(60) are plotted versus depth and presented on screen.

Other:	The groundwater level affects the calculation of effective overburden stress (σ'v) used in the correlations. In addition, user can choose to apply the water level correction on SPT blow counts, as proposed by Terzaghi. This correction is recommended for N⩾15 in silty sands: Ncor=15+0.5(N60-15)
Soil Layers:	This data is used to calculate the effective and total overburden stress at each depth where correlations are required. Please pick the soil grain size for each layer from the drop down list (Coarse / Fine). This is used by Dartis SPT to filter correlations based on grain size. Some SPT correlations depend on OCR and Cu of the soil. These parameters should be specified for each soil layer. This data can be entered manually or maybe imported from Excel.
SPT data table:	In this table please enter raw data gathered from SPT test. The first two columns of this table include depth and SPT blow counts (N) and the other columns are automatically calculated during data entry. When this data is entered, Click on 'Plot Charts' to update and present both SPT blow counts and correction factors along depth of borehole. This data can be entered manually or maybe imported from Excel.

Note: Never enter zero for a SPT test depth; it may lead to calculation errors. This is due to dependency of most Cn methods to σv which will be zero at Z=0.

Adding row to Tables

For adding a new row to a table, simply press button on top-right side of the table or right click on table header and choose 'New Row' between options.

Clearing Tables

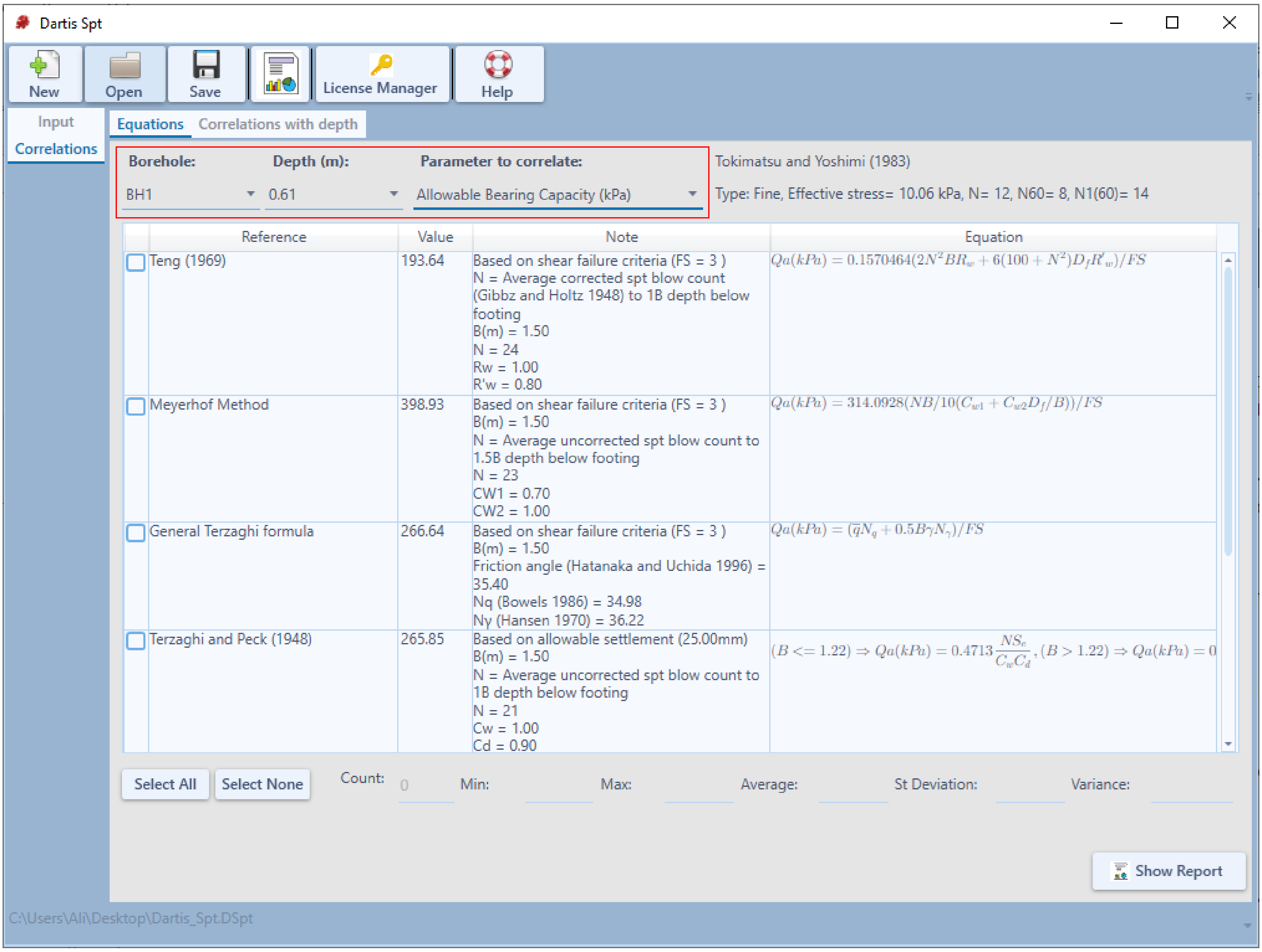
For clearing all data entered in a table, simply press button on top-right side of the table or right click on table header and choose 'Clear Table' between options.

SPT Graph

Once you enter SPT versus depth data, and press 'Plot Charts' button at the bottom-right corner of the screen, SPT graph is updated and un-corrected as well as corrected SPT numbers are plotted versus depth. Another graph shows the variation of SPT correction factors against depth. Right Click on each graph to print it.

Analyzing a borehole

When data entry is finished for the selected borehole, simply click on the 'Analyze borehole' button. This will calculate correlations and then you can choose 'Correlations' then 'Equations' Tab in which by selecting the required 'Borehole', 'Depth' and 'Parameter to correlate'; correlations are provided for this depth of selected borehole.

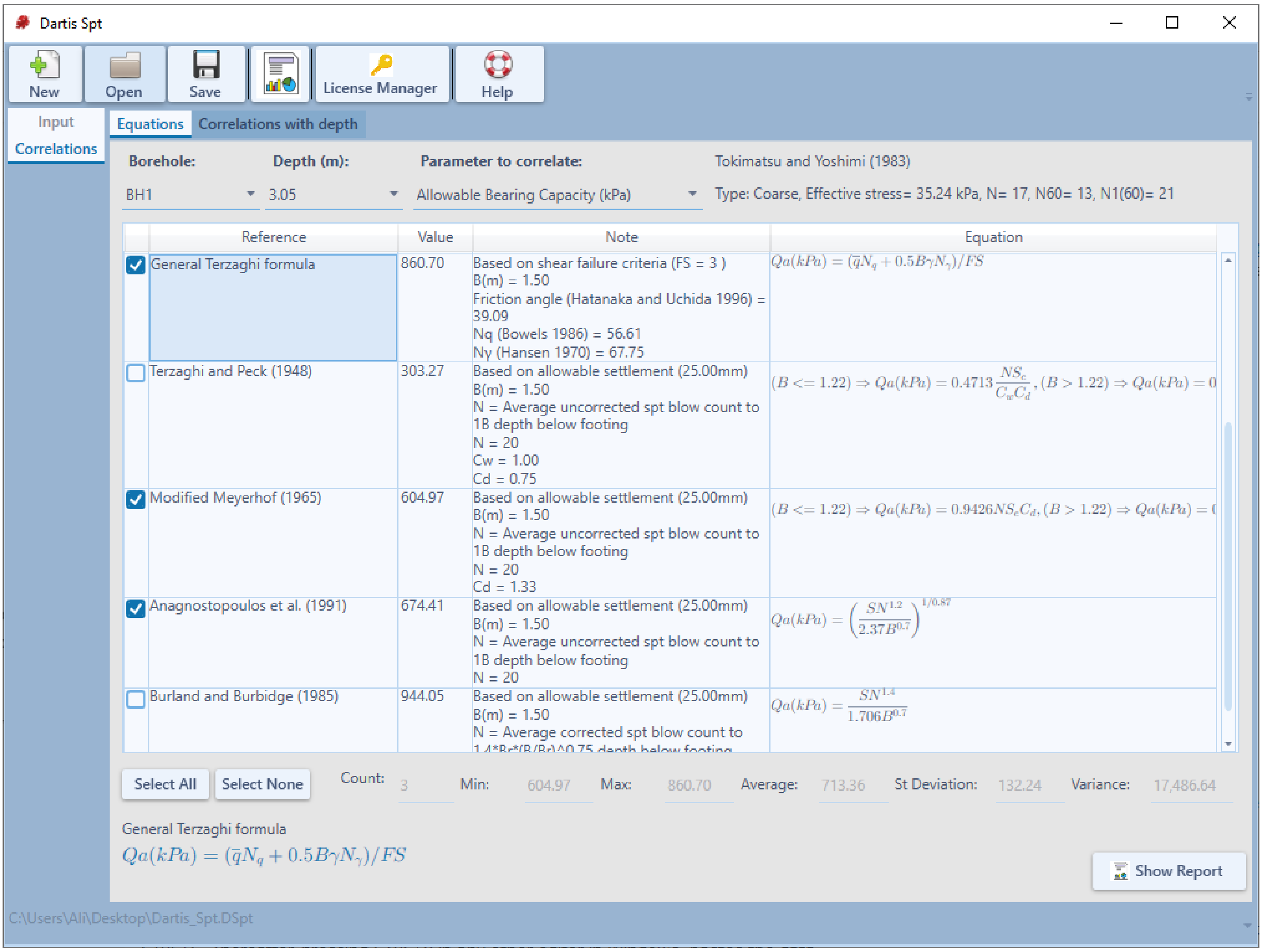

Dartis Spt
New
Open
Save
License Manager
Help
Input
Correlations
Equations
Correlations with depth
Borehole:
Depth (m):
Parameter to correlate:
BH1
0.61
Allowable Bearing Capacity (kPa)
Tokimatsu and Yoshimi (1983)
Type: Fine, Effective stress= 10.06 kPa, N= 12, N60= 8, N1(60)= 14
Reference
Value
Note
Equation
Teng (1969)
193.64
Based on shear failure criteria (FS = 3)
N = Average corrected spt blow count (Gibbz and Holtz 1948) to 1B depth below footing
B(m) = 1.50
N = 24
Rw = 1.00
R'w = 0.80
$Qa(kPa) = 0.1570464(2N^2BR_w + 6(100 + N^2)D_fR'_w)/FS$
Meyerhof Method
398.93
Based on shear failure criteria (FS = 3)
B(m) = 1.50
N = Average uncorrected spt blow count to 1.5B depth below footing
N = 23
CW1 = 0.70
CW2 = 1.00
$Qa(kPa) = 314.0928(NB/10(C_{w1} + C_{w2}D_f/B))/FS$
General Terzaghi formula
266.64
Based on shear failure criteria (FS = 3)
B(m) = 1.50
Friction angle (Hatanaka and Uchida 1996) = 35.40
Nq (Bowels 1986) = 34.98
Nγ (Hansen 1970) = 36.22
$Qa(kPa) = (\overline{q}N_q + 0.5B\gamma N_\gamma)/FS$
Terzaghi and Peck (1948)
265.85
Based on allowable settlement (25.00mm)
B(m) = 1.50
N = Average uncorrected spt blow count to 1B depth below footing
N = 21
Cw = 1.00
Cd = 0.90
$(B <= 1.22) \Rightarrow Qa(kPa) = 0.4713\frac{NS_e}{C_wC_d}, (B > 1.22) \Rightarrow Qa(kPa) = 0$
Select All
Select None
Count:
0
Min:
Max:
Average:
St Deviation:
Variance:
Show Report
C:\Users\Ali\Desktop\Dartis_Spt.DSpt

5.2. Toolbar

1.Creates a new project: by clicking on 'New' button, a dialogue will open. Choose the location where you want the project to be saved. Files are saved with *.DSpt extension and the complete file path is shown at the bottom of the page.
2.Opens a previously created project file: by clicking on Open button, an open dialogue will show up. Choose the save file on your local hard. Files are stored with *.DSpt extension.
3.Saves currently open project: saves current project's information on currently open save file. The save file path is shown at the bottom of the page.
4.Opens report
5.Opens License Manager window.
6.Opens Help

5.3. Correlated results

When data entry in Dartis SPT is completed, press 'Analyze borehole' button. In Correlations and then Equations tab results are available. Dartis SPT uses more than 200 correlations to prepare these results. For each soil parameter in depth of a selected borehole (e.g. "Allowable bearing capacity"), all available correlations are summarized in a table describing the reference, parameter value, Equation, and Notes regarding each correlation used. The following screen shot shows the correlation table:



Sorting

By clicking on the 'Value' header, rows are sorted numerically.

By clicking on the 'Reference' or 'Note' headers, rows are sorted alphabetically.

Correlated results Report

Each method may be turned on/off by using the check box in the first column and will be added/removed from the designed report for this tab. Statistical variables are calculated for selected methods.

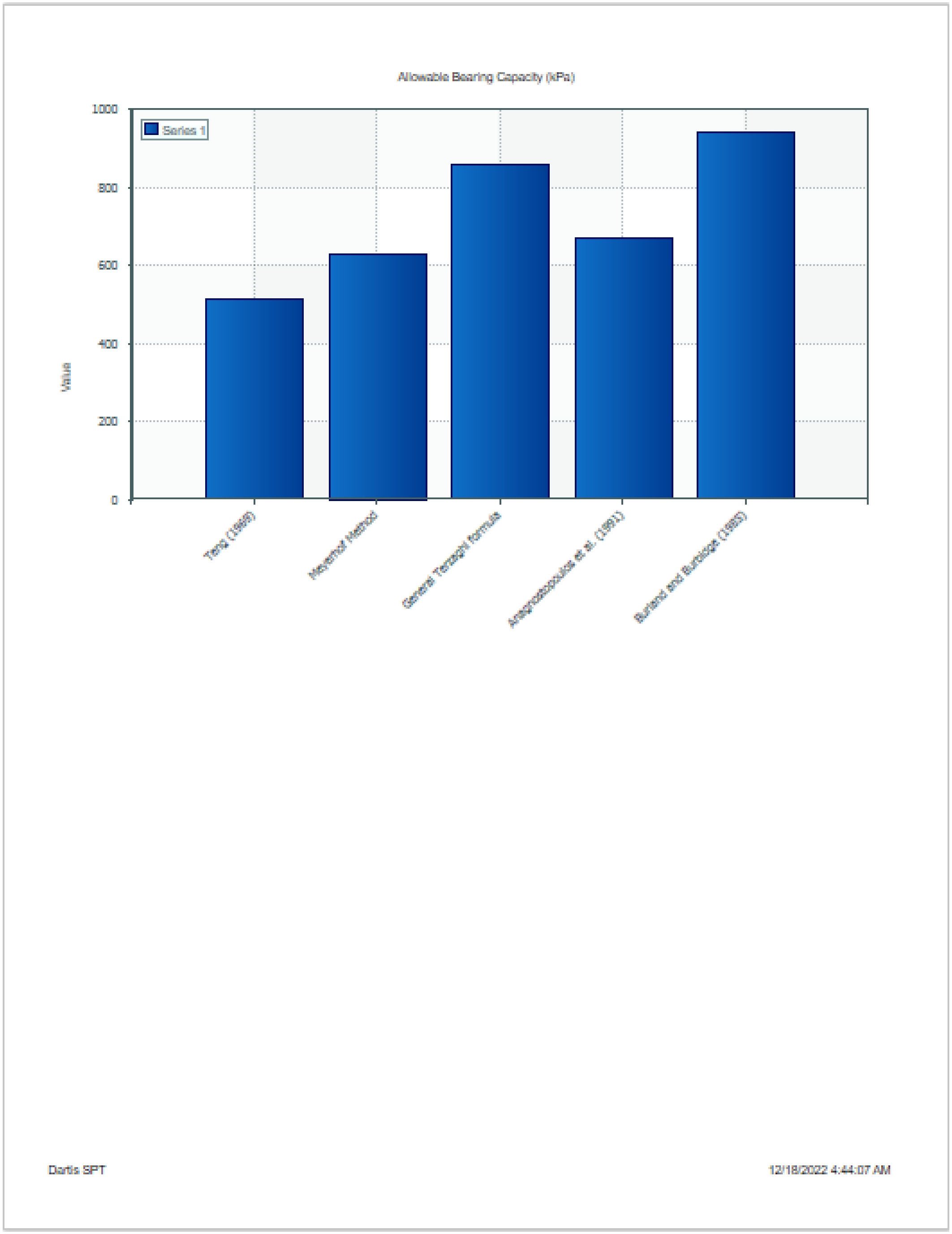
The following screen shots show a sample Report regarding this page:

Project:	Job No. :	Location:	Client:
Sample project	123456	Sample location	Sample Client

Borehole:	Depth (m):	Parameter:	Overburden correction:
BH1	3.05	Allowable Bearing Capacity (kPa)	Tokimatsu and Yoshimi (1983)

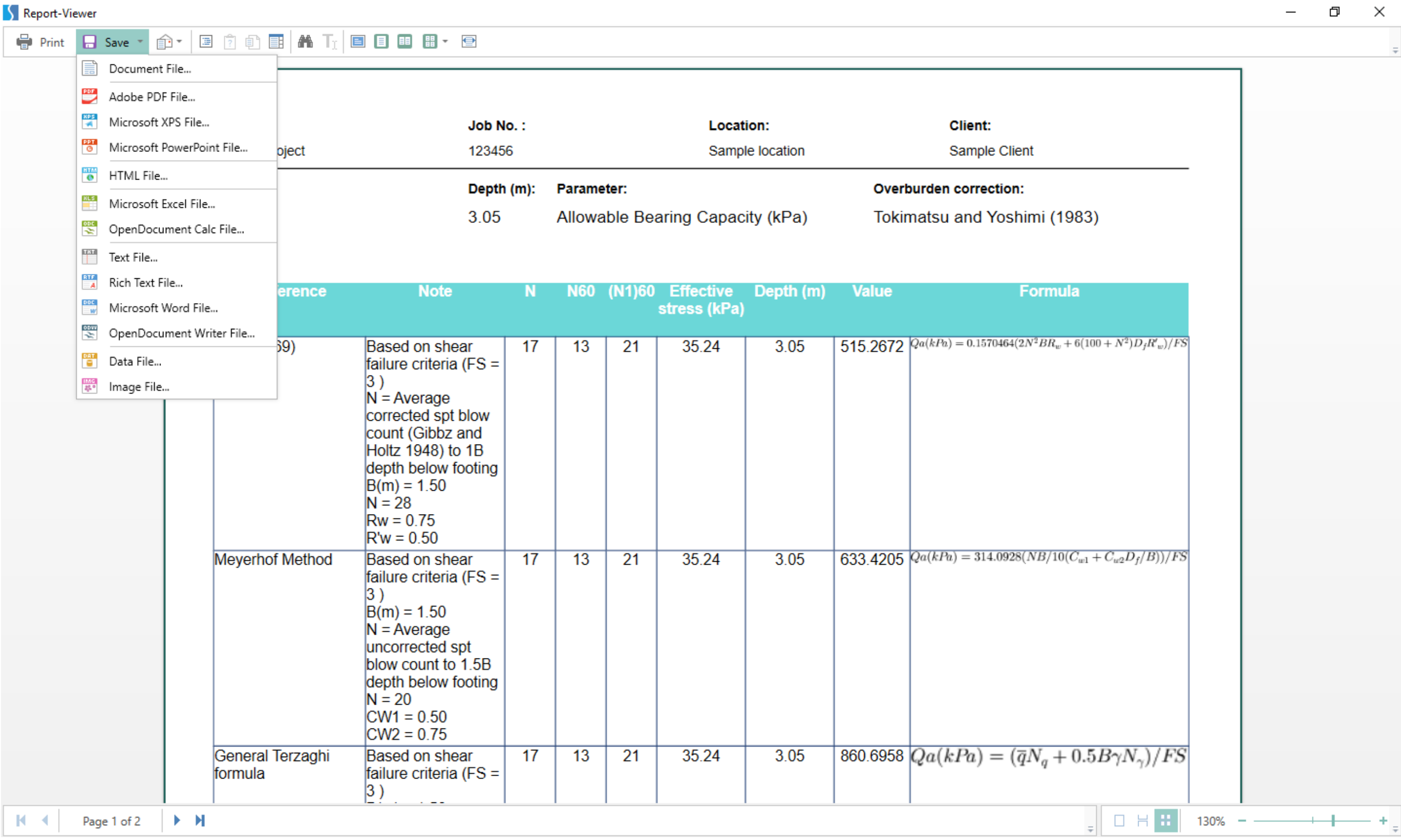
Reference	Note	N	N60	(N1)60	Effective stress (kPa)	Depth (m)	Value	Formula
Teng (1969)	Based on shear failure criteria (FS = 3) N = Average corrected spt blow count (Gibbz and Holtz 1948) to 1B depth below footing B(m) = 1.50 N = 28 Rw = 0.75 R'w = 0.50	17	13	21	35.24	3.05	515.2672	$Qa(kPa) = 0.1570464(2N^2BR_w + 6(100 + N^2)D_fR'_w)/FS$
Meyerhof Method	Based on shear failure criteria (FS = 3) B(m) = 1.50 N = Average uncorrected spt blow count to 1.5B depth below footing N = 20 CW1 = 0.50 CW2 = 0.75	17	13	21	35.24	3.05	633.4205	$Qa(kPa) = 314.0928(NB/10(C_{w1} + C_{w2}D_f/B))/FS$
General Terzaghi formula	Based on shear failure criteria (FS = 3) B(m) = 1.50 Friction angle (Hatanaka and Uchida 1996) = 39.09 Nq (Bowels 1986) = 56.61 Nγ (Hansen 1970) = 67.75	17	13	21	35.24	3.05	860.6958	$Qa(kPa) = (\bar{q}N_q + 0.5B\gamma N_\gamma)/FS$
Anagnostopoulos et al. (1991)	Based on allowable settlement (25.00mm) B(m) = 1.50 N = Average uncorrected spt blow count to 1B depth below footing N = 20	17	13	21	35.24	3.05	674.4098	$Qa(kPa) = \left(\frac{SN^{1.2}}{2.37B^{0.7}}\right)^{1/0.87}$
Burland and Burbidge (1985)	Based on allowable settlement (25.00mm) B(m) = 1.50 N = Average corrected spt blow count to 1.4*Br*(B/Br)^0.75 depth below footing Br = 0.3m N = 24	17	13	21	35.24	3.05	944.0453	$Qa(kPa) = \frac{SN^{1.4}}{1.706B^{0.7}}$

Count:	Average:	Min:	Max:	Variance:
5	725.57	515.27	944.05	30,331.65



Exporting Formats

In report viewer choose exporting format by clicking on Save button:

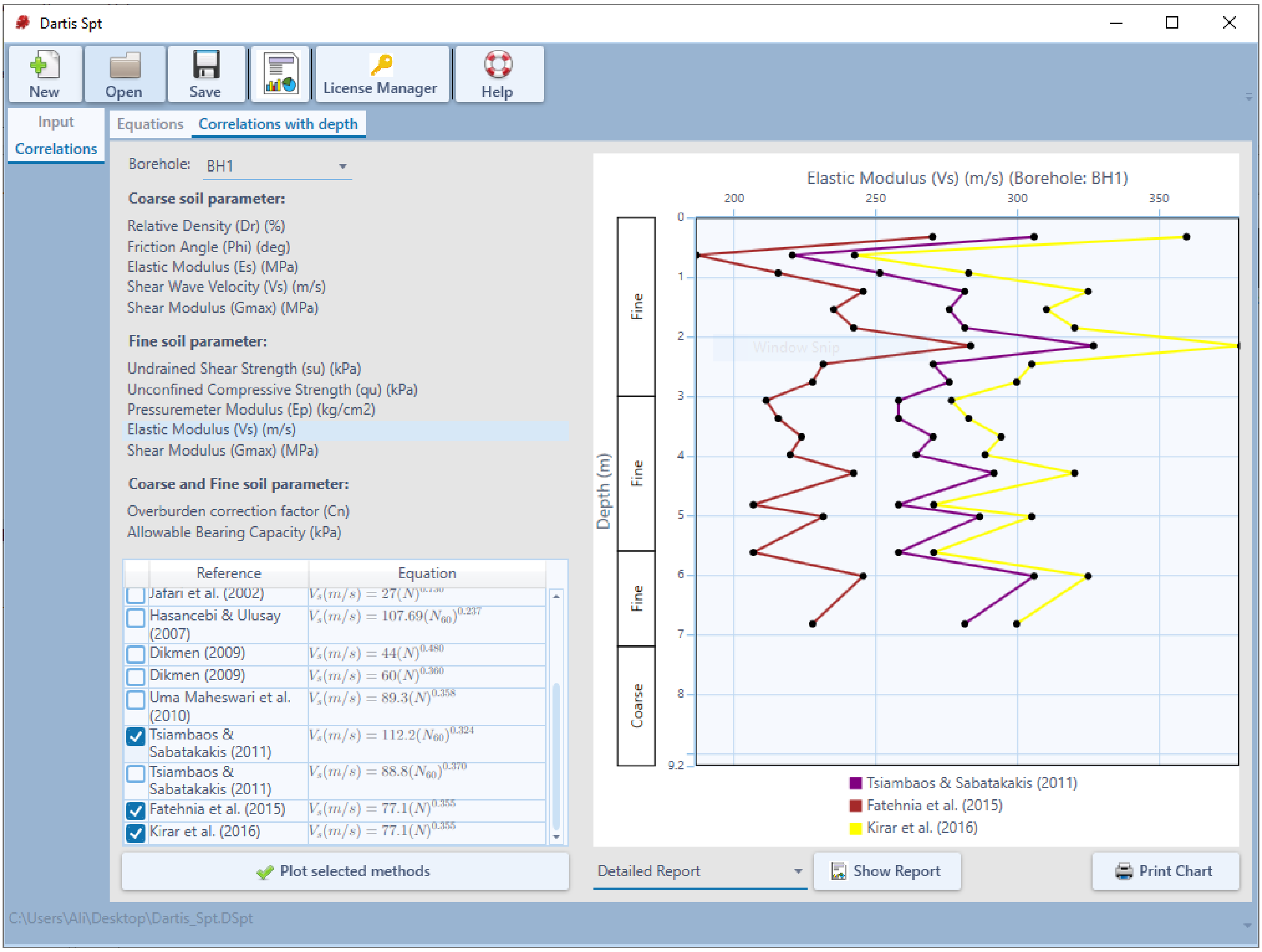


Report-Viewer
Print
Save
Document File...
Adobe PDF File...
Microsoft XPS File...
Microsoft PowerPoint File...
HTML File...
Microsoft Excel File...
OpenDocument Calc File...
Text File...
Rich Text File...
Microsoft Word File...
OpenDocument Writer File...
Data File...
Image File...
Job No. :
123456
Location:
Sample location
Client:
Sample Client
Depth (m):
3.05
Parameter:
Allowable Bearing Capacity (kPa)
Overburden correction:
Tokimatsu and Yoshimi (1983)
Note
N
N60
(N1)60
Effective stress (kPa)
Depth (m)
Value
Formula
Based on shear failure criteria (FS = 3) N = Average corrected spt blow count (Gibbz and Holtz 1948) to 1B depth below footing B(m) = 1.50 N = 28 Rw = 0.75 R'w = 0.50
17 13 21 35.24 3.05 515.2672
Meyerhof Method
Based on shear failure criteria (FS = 3) B(m) = 1.50 N = Average uncorrected spt blow count to 1.5B depth below footing N = 20 CW1 = 0.50 CW2 = 0.75
17 13 21 35.24 3.05 633.4205
General Terzaghi formula
Based on shear failure criteria (FS = 3)
17 13 21 35.24 3.05 860.6958
Page 1 of 2
130%

5.4. Correlation with depth

This feature is designed to plot the variation of a soil parameter in depth of a borehole based on SPT blow counts, and is accessible from Correlations → Correlations with depth. Follow these steps to obtain the correlation in depth of borehole:

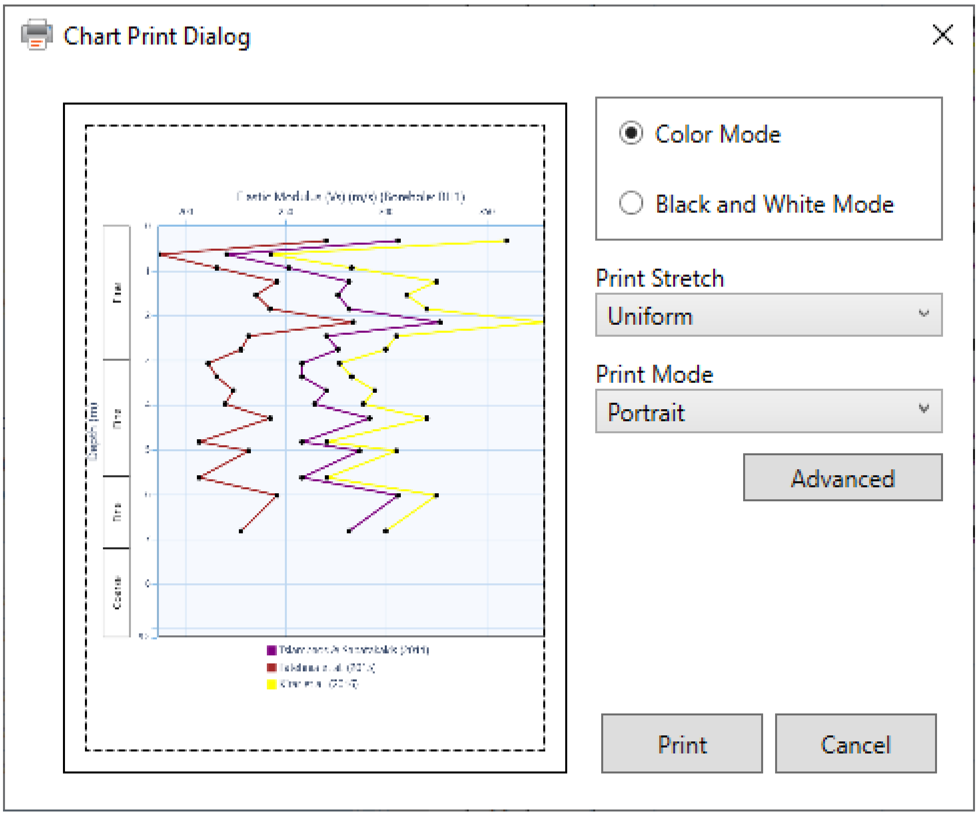
1.Select the desired soil parameter (Elastic Modulus is selected in the following screen shot)
2.Select the correlations from the list (Three of the selected methods can be seen in the screen shot)
3.Click on 'Plot Selected Methods' button
4.If necessary, remove or include more methods from the list and repeat step 3



Note : By choosing a Fine soil parameter, the graph will plot along fine soil layers. Soil grain size at a depth is obtained from soil layers input.

Printing Chart

Either click on 'Print Chart' button at bottom right side of page or right click on the chart and choose 'Print Chart' between options. A chart print dialogue will open. Click on 'Print'.

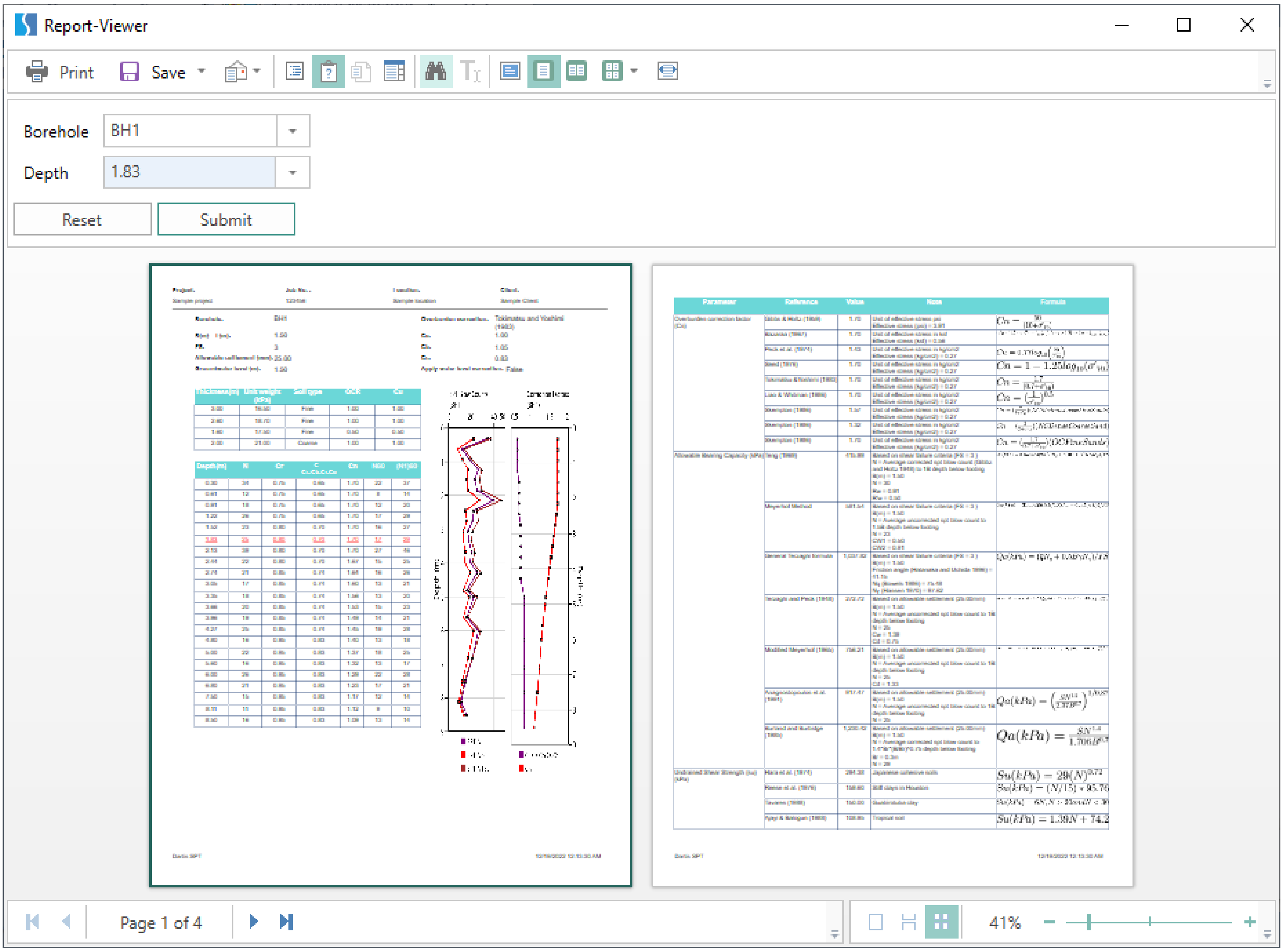


Correlations with depth Report

Each method may be turned on/off by using the check box in the first column and will be added/removed from the designed report for this tab.
From the combo box choose required report (Detailed Report / Standard Report / Only data table report) and click on 'Show Report'.

5.5. Report

By clicking on  button on toolbar, report viewer opens. Simply select the Borehole and then the required Depth. Click on Submit button. This will generate the report. Report can be Printed or be saved in desired format (PDF, Excel, Word, Image ...).



System Requirements

Min. 1024×768 Screen Resolution
Windows 7, 8, 8.1 and 10 (up-to-date)
Microsoft .Net 4.7.2
100 MB of Disk Space