

# UNISETTLE Version 3

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## Calculation of Stress Distribution and Total and Differential Settlement

Almost daily, a geotechnical engineer needs to determine stress distribution and settlement for complex conditions by means of fundamental geotechnical engineering formulae. UniSettle was developed to assist engineers in performing complete calculations—however complex the combination of loads—and to document the results of the calculations. The relevant borehole data (soil layers and soil parameters) are entered quickly without the User having to learn and remember a complicated procedure. Input is made from keyboard or by mouse. The desired calculation of stress and/or settlement is chosen from an analysis menu and the results can be seen on the screen and printed out in tables and diagrams

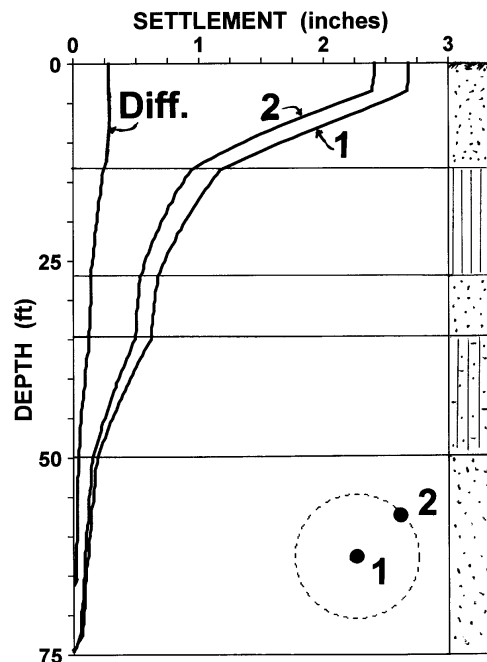
UNISETTLE includes the following main features:

- Stress distribution is calculated according to Boussinesq, Westergaard, or 2:1 methods and combines the loading and unloading effects of a multitude of loaded areas
- The load areas can be subjected to uniform or non-uniform stress distribution.
- The effect of unloading due to excavation can be included with equal ease.
- Changes of groundwater table depth and other pore pressure changes can be imposed.
- Stresses can be from a combination of point loads, line loads, or from circular, triangular, or rectangular load areas—in fact, any combination of arbitrarily shaped polygons.
- Settlement, can be calculated by means of  $c_c$ - $e_0$  method,  $E$ modulus method, or by the Janbu tangent modulus method as per the Canadian Foundation Engineering Manual (1992) and the results are presented in a table on the screen and/or printed out on hard copy, or to file.
- The soil layers can be preconsolidated as expressed by either a constant or an OCR-value. The preconsolidation can vary within a soil layer.

- The settlement can be determined in the form of total settlement at one point or differential settlement between two points. The points can be arbitrarily located.
- Diagrams showing vertical distribution of stress or settlement can be plotted to screen and sent for output to a graphic printer or to file.
- The data input can be in either English or SI-units and, by a keystroke, the converted from one system of units to the other and back again.
- The program is built from succinct pull-down windows and is operated by either mouse or keyboard commands.

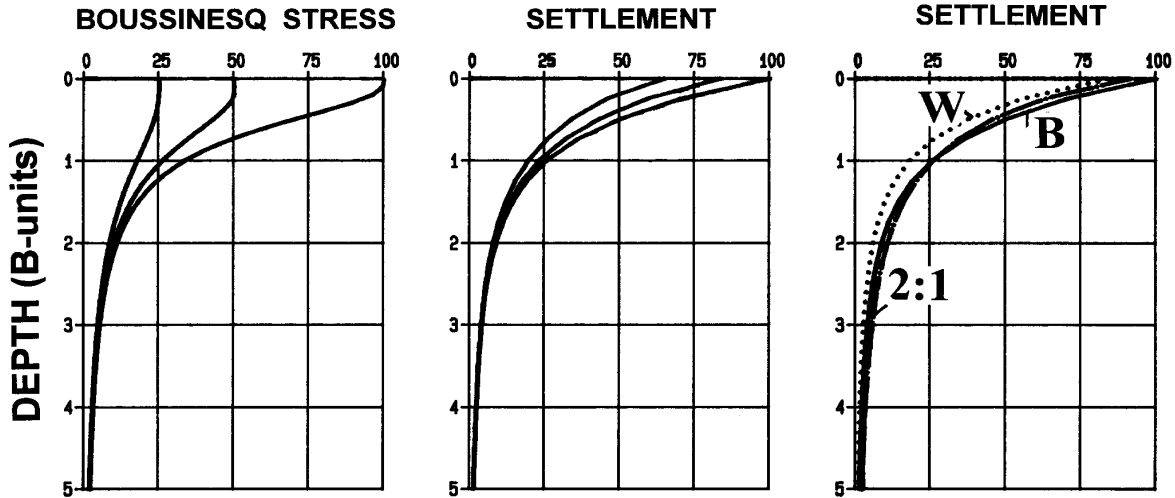
The UNISETTLE manual contains a Background to stress distribution and settlement calculations, a Reference Manual that sequentially details the many calculation options provided by the program, and several solved examples. The examples are available on the UniSettle distribution disk for the User's personal practice in using the program.

UniSettle is simply a must for all Foundation Engineers.



The diagram illustrates the distribution of total and differential settlement as calculated by UniSettle for a 50 feet wide circular tank. The soil consists of a layers of clay and silt alternating with sand layers (as indicated in the column to the right of the diagram). The stress distribution is computed by the Boussinesq method.

The following set of diagrams illustrates another application of UniSettle:



**LEFT DIAGRAM** Stress distribution by the Boussinesq method below the center of three square footings loaded by equal load (100 load units). The footings have side lengths equal to B, (area  $B^2$ ),  $B\sqrt{2}$  (area  $2B^2$ ), and  $2B$  (area  $4B^2$ ). The contact stresses for the three footings are, thus, equal to 110, 50, and 25 stress units.

**CENTER DIAGRAM** Units of settlement for the three footings calculated for the contact stresses

The settlement of the smallest footing is about 2/3 of the largest. Thus, the diagram illustrates the importance of considering also the width of the footing, not just the stress.

**RIGHT DIAGRAM** Distribution of settlement for the first footing calculated by means of Boussinesq (B), Westergaard (W), and 2:1-methods.

Notice, for a single footing, the method of stress calculation matters little. However, when the effect of several loaded areas are combined, the method matters.

Units : (kg/m<sup>3</sup>)

Layers	1	2	3	4	
Type	Old Fill	Clay Crust	Clayey Silt	Sand	Cl
Thickness	2.	3.	4.	6.	7.
Depth	2.	5.	9.	15.	22.
Density	1900.	1730.	1950.	2050.	19
Exp. i	0.	0.	0.	0.	0.
m (t/b)	100000./100000	35./15.	15./20.	26.1/26.1	25
mr (t/b)	0./0.	90./90.	0./0.	0./0.	0.
dp (t/b)	0./0.	0./0.	15./15.	0./0.	0.
OCR (t/b)	1./1.	5./2.	1./1.	1./1.	1.
Step	2.	1.	2.	6.	7.

Transfer...      OK

A portion of UniSettle's Input Window showing input for the first four soil layers of a soil profile. The compressibility parameters are given at top and bottom of each soil layer and, when the parameters are different, the program interpolates within sub-layers of thickness controlled by the "Step" value. Parameters are explained in the manual and by immediately accessible contents-sensitive help text. The "Transfer" button will let the User input  $C_c$ - $e_0$ ,  $C_{cr}$ - $e_0$ , and  $E$  modulus parameters instead of the modulus numbers  $m$  and  $m_r$ .

Ground Elevation (m) : 100.

Area (m<sup>2</sup>) : 48.

Load No. : 1      Label : Main slab

Rectangular load

Center Coordinates

Coord. X (m)	Coord. Y (m)	Load (kN)	Stress (kPa)
1 : -5.	7.	2688.	56.

Length (m) : 6.      Width (m) : 8.

Depth (m) : 2.      Elev. (m) : 98.

Application

Initial Conditions

Final Conditions

Stress Distribution

Formula

Constant

Integration

Precision (m) : 1.

OK      Reset

A window showing UniSettle's input for a loaded rectangular area (with center coordinates and side lengths). Both load and stress are indicated and either can be input to give the other. The tick in the box at "Final Conditions" means that the load will increase stress and cause settlement. If "Initial" had been ticked, too, no settlement had been caused. To indicate removal of the load, only "Initial" would have been ticked, and a heave would have resulted.

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