

DownHole

Part I GeoStru Software	1
1 Autoupdate	2
2 Copyright	2
3 Customer technical support service	3
4 Contact	3
Part II DownHole	4
1 Work theory	4
Introduction	4
Experimental procedure	6
Direct method	6
Interval method	9
2 Menu	10
File	10
Edit	11
View	11
Export	12
Options	12
Utility	12
3 Input	13
4 Output	13
Part III SEG2 file import	14
Part IV Geoapp	21
1 Geoapp Section	21
Part V Recommended books	22
Index	0

1 GeoStru Software



The GeoStru Software company develops technical and professional software for geotechnical engineering, civil engineering, geology, geomechanics, hydrology, soil testing, geophysics.

Thanks to GeoStru Software you can now use the most effective tools for your own profession. The GeoStru software represents a complete, reliable (the computation algorithms are the most technologically advanced in the research field worldwide), regularly updated, easy to use tool with an intuitive user interface.

Attention to customer service and the development of software using modern technologies allowed us to become one of the strongest companies in the field on international markets. The software – currently translated into eight languages – is compatible with international computation rules / normatives and it is one of the most used in over 50 countries worldwide.

GeoStru is always present at the main exhibitions in the field, both in Italy and abroad SAIE Bologna, MADEEXPO Milano, GeoFluid Piacenza, ExpoEdilizia Roma, Restructura Torino, SEEBE Belgrad, Construct EXPO Bucuresti, EcoBuild Londra, Construtec Madrid, The Big 5 Dubai etc.

Today working with GeoStru is more than just buying software – it means having beside you a team of professionals willing to share their knowledge and experience for excellent results.

There are many areas where the company has specialized in over the years.

The family of GeoStru products is, in fact, divided into several categories:

- Structures
- Geotechnics and geology
- Geomechanics
- In situ soil tests
- Hydrology and Hydraulics
- Topography
- Energy

- Geophysics
- Office

For further information about our products please visit our website <http://www.geostru.eu>

Among the many services offered by GeoStru Software you can use the free service GeoStru Online that includes software applications on the web that will help you solve many different problems.

ISO 9001:2008 certification

CVI Italia s.r.l. awarded GeoStru Software the UNI EN ISO 9001 company certification on 1st June 2009, certificate no. 7007, for software design and sale.

1.1 Autoupdate

The software comes with an integrated auto-update system.

A few seconds after opening the software, by moving the mouse pointer on the indication of version (shown in the bottom right side of the main window: Geostru _._._._), the user can check whether or not it is available an update of the software.

If a message will warn the user about the availability of an updated version, the user can automatically update the software by clicking on the icon of the message.

In the event that there are no updates available, the message shown will be "No updates available."

1.2 Copyright

The information contained herein is subject to change without notice.

Unless otherwise noted, any reference to companies, names, addresses and data used as examples are purely coincidental and is intended only to illustrate the use of the product.

Compliance with all applicable copyright laws is the responsibility of the user.

No part of this document may be reproduced in any form or by any means electronic or mechanical, for any purpose, without the written permission of GeoStru Software. However, if the user has the sole means of access the electronic mean, then it will be authorized, in base of this document, to print a copy.

1.3 Customer technical support service

For any queries regarding a GeoStru product:

- Consult the documentation and other printed material
- Consult the Help OnLine section
- Consult the technical documentation used for software development (Web Site)
- Consult the FAQ area (Web Site)
- Consult the GeoStru support services (Web Site)

It is active the new ticket support service developed by GeoStru Software in order to respond to our users support requests.

This service, reserved to registered users and owners of valid licenses, allows you to get answers to your requests regarding different aspects of your programs directly from our specialists (Web Site).

Web Site: www.geostru.eu

1.4 Contact



Web: www.geostru.eu

See the contact page on the website for more information about our contacts and offices' addresses in Italy and abroad.

2 DownHole

2.1 Work theory

2.1.1 Introduction

The down hole seismic method (DH) measures the time taken for the P and S waves to move between a seismic source located on the surface of the ground, and the receivers, placed inside a borehole (Fig. 1, 2).

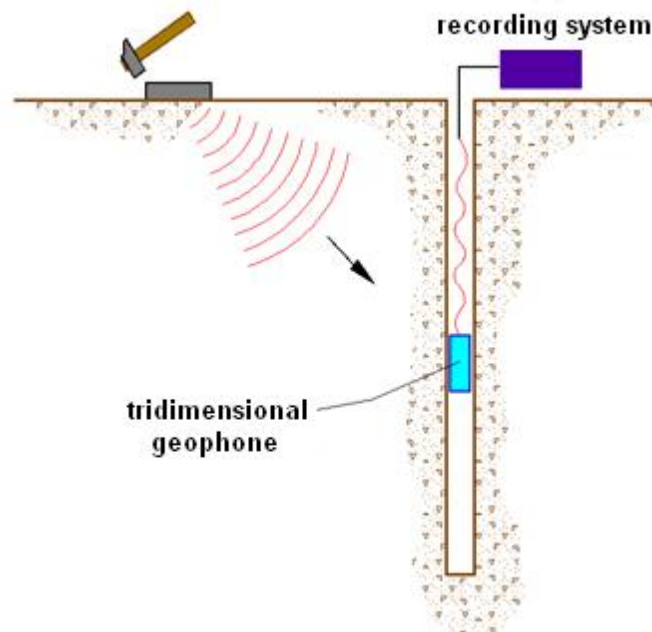


Figure 1 - Schematic down hole to a single receiver

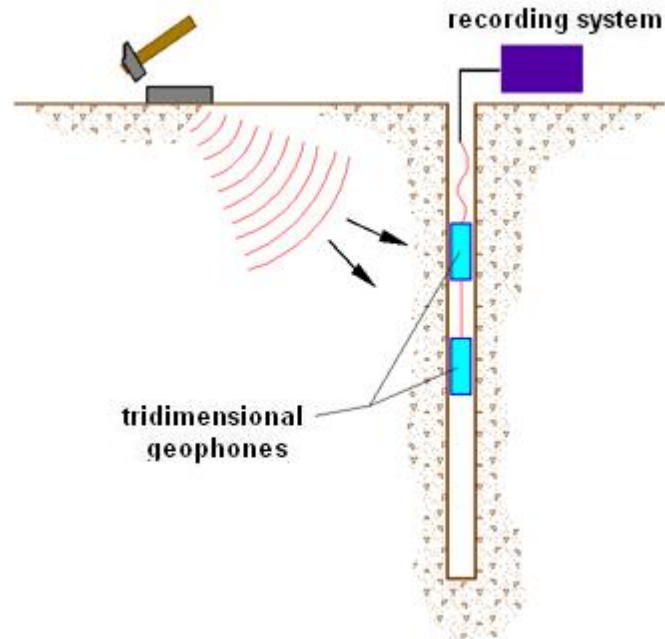


Figure 2 - Schematic down hole to two receivers

The components necessary for an accurate DH test consist of :

1. mechanical source capable of generating energy and elastic unidirectional waves ;
2. one or more three-dimensional geophones, with appropriate frequency directional response (4.5 to 14 Hz), having an anchoring system to the walls of the pipe-hole;
3. a multi-channel seismograph, capable of recording in digital mode the wave forms and to record them on mass storage;
4. a transducer (trigger) located in the source, necessary to identify the instant of departure of the dynamic stress using a hammer hitting a steel plate or ball placed on the ground.

During drilling, to reduce the noise effect in the ground, the holes are supported through a benthic mud; their diameter is maintained rather small (average $\varnothing = 15$ cm).

The holes are then covered by pipeline, generally PVC, and filled with a shrinkage - controlled mortar, usually composed of water, cement and bentonite respectively at a ratio of 100, 30 and 5 parts by weight.

First of all, it is important to make sure that the hole is free of bottlenecks and the pipe coating does not present cracks.

2.1.2 Experimental procedure

The source consists of an aluminum plate that, after the ground plane is prepared, is placed so that the plate is lying on the surface at a distance of 1,5 to 2,5 m from the hole and oriented in the direction orthogonal to the outgoing axis within the hole.

At the source is hooked the speed sensor used as a trigger. If you have two receivers, these are connected so as to prevent relative rotation and to set the distance. The first of the two receivers is connected to a rod (ground) battery that allows the orientation from the surface and the moving. Once at the test depth, the geophones are oriented so that each sensor is a transducer, parallel to the axis of source (absolute orientation). At this point, the receivers are secured to the walls of pipe coating, the source will be affected in the vertical direction (to generate waves compression P) or laterally (to generate shear waves SH) and, simultaneously start the registration of trigger signal and receivers.

Once the registrations are recorded, the depth of the receivers is changed and the test procedure repeated.

2.1.3 Direct method

In order to interpret the down hole with the direct method, initially, we must correct the travel times (t) measured along the source-receiver paths to take into account the inclination of the path of the waves. If d is the distance from the source axis of the hole (Figure 1), r the distance between the source and the triplet of sensors, z the depth and we can get the correct time (t_{cor}) using the following conversion formula:

Formula 1.0

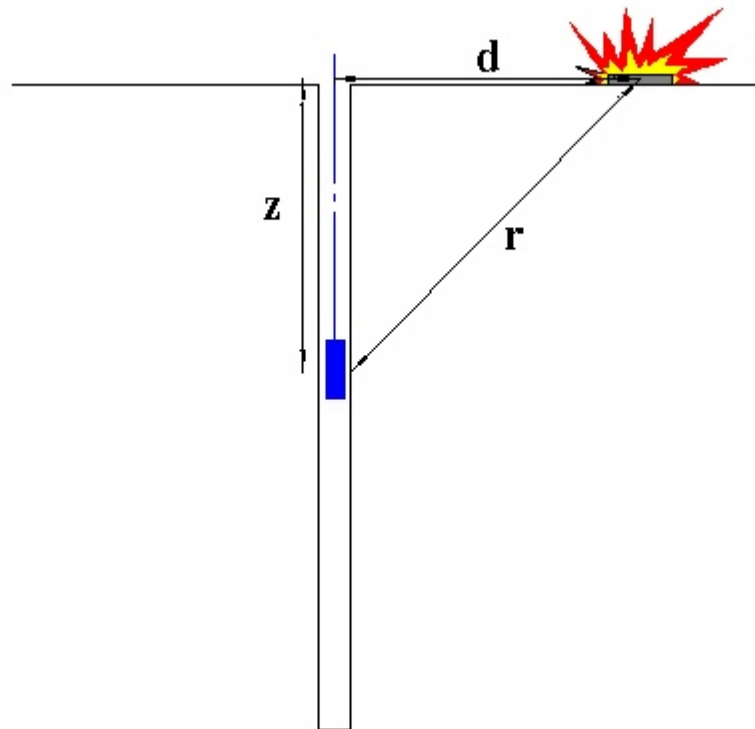


Figure 1 – Schematic down hole with direct method

The corrected time for the P waves and for S waves being calculate, is drawn the graphic $t_{\text{cor}} - z$, so that the average speed of seismic waves in homogeneous layers of soil is represented by the inclination of the line segments along which are aligned to the experimental data (Figure 2).

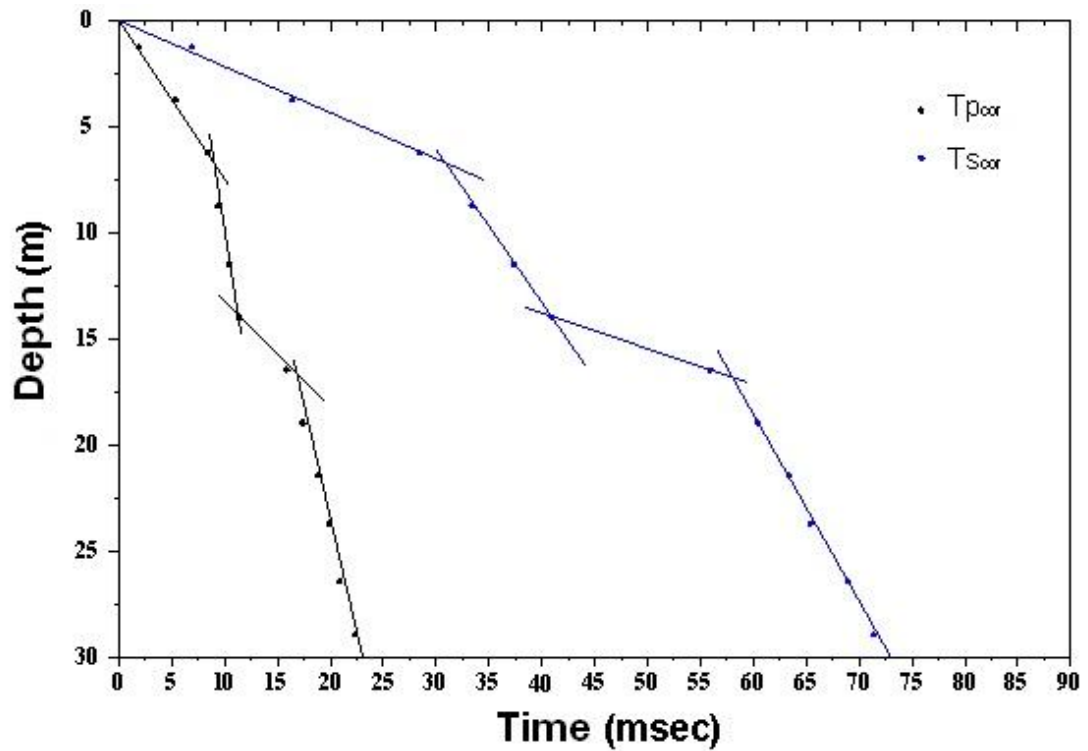


Figure 2 - Time travel graphs

Once the seismic layers are graphically obtained, you get the average density, from the speed and depth, and the following parameters:

1. average Poisson's ratio:

$$v_{average} = 0.5 \frac{\left(\frac{V_p}{v_s}\right)^2 - 2}{\left(\frac{V_p}{v_s}\right)^2 - 1}$$

2. average shear deformation modulus:

3. average oedometric modulus:

$$E_{d \text{ average}} = \rho V_p^2$$

4. average Young's modulus:

$$E_{\text{average}} = 2 \cdot \rho v_s^2 (1 + \nu)$$

5. average bulk modulus:

$$E_{v \text{ average}} = \rho \left(v_p^2 - \frac{4}{3} v_s^2 \right)$$

2.1.4 Interval method

In the interval method, travel times are measured between two receivers row (Figure 1) placed at different depths, thus allowing for better quality measurements (speed intervals).

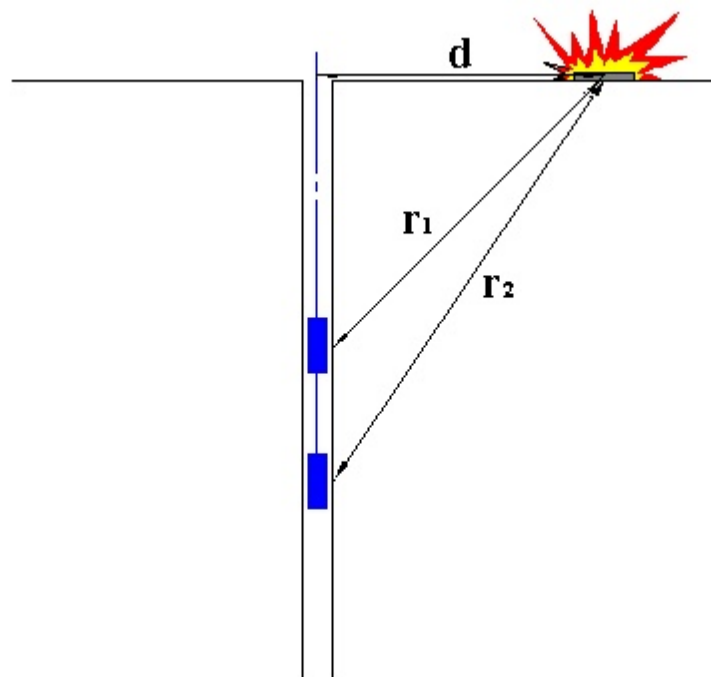


Figure 1 - Diagram of down hole using interval method

When you have only one receiver, that is assuming that the pairs do not match a single impulse, the rate determined values are defined in the

pseudo-range, allowing only an apparent better definition of the velocity profile. The obtained measurements make possible to calculate the correct time using 1.0 formula and the speed range of P and S waves, with the graph (Figure 6), with the following formula:

$$v_{p,s} = \frac{z_2 - z_1}{t_{2cor} - t_{1cor}}$$

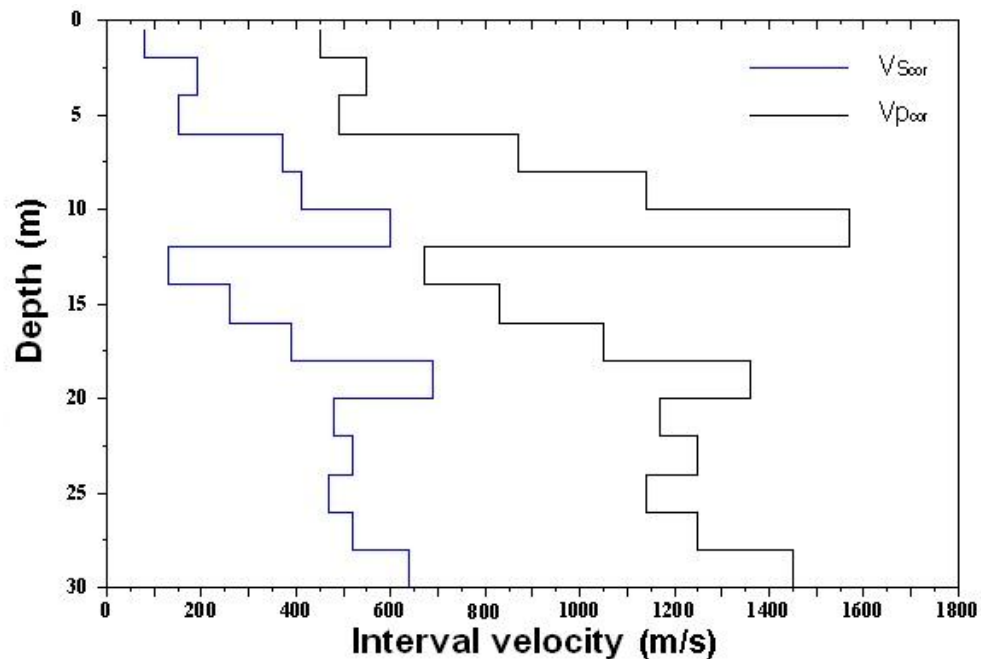


Figure 2 - Profile of seismic velocity with range method

With the calculated speed range is possible to calculate the density, the Poisson's ratio, the shear deformation modulus, the oedometric modulus, Young's modulus, the bulk modulus for each interval, with the formulas above. But the method has its limitations:

- a) does not take into consideration the speed of the overlying strata;
- b) is not applicable if $t_{2cor} < t_{1cor}$

2.2 Menu

2.2.1 File

New

Creates file(s) for a new project..

Open

Opens file(s) from a previously created project.

Save

Save file(s) for the currently open project, replacing any previous version.

Save as

Save file(s) for the currently open project under the name and in the folder entered in a subsequent dialogue window.

SEG2 file import

Import data from SEG2 files

Exit

Exit from program.

2.2.2 Edit

Copy image

Copies to the clipboard the selected area of the active window.

2.2.3 View

Display soil textures

Display or hide the window with textures.

Zoom window

Lets you draw a selection rectangle or "window" to zoom part of your display in the drawing window. Use the left button to select one corner of the view you want. Now the cursor becomes a stretching rectangle. Select a second corner for the view. The screen is redrawn to show the part of your drawing that fits within the rectangle.

Zoom all

A zoom factor is applied, such that the whole content of the worksheet is displayed.

Move

Enables frame around the drawing to be moved by dragging the drawing. Note that actual coordinates of the drawing do not change but the frame's scales do.

Text

Change the font size.

2.2.4 Export

Print report

Display the computation report in an internal editor window which allows to Save in a DOC format file that can be read by most text processing programs and also can be printed from its own File menu. The report includes a theoretical introduction, the results of the analysis and also the graphs and diagrams.

Export in DXF format

Export in DXF format the contents of the worksheet window for the purpose of further elaboration by a CAD program.

Export in Bitmap format

Export in BMP format the contents of the worksheet window.

2.2.5 Options

Options

Allows customization of the working parameters such as graphics colors, printing margins and so on.

2.2.6 Utility

Stratigraphy

In this section you can assign and customize the stratigraphy for the study area. This can be assigned directly by using the input from the left

side of the workspace or be derived from seismic data stratigraphy defined during the analysis phase. To this end, is simply to import the data interest from the Run menu. Each layer can be customized by inserting a color or textures and a customized description. Textures can be activated by selecting the dedicated button on the toolbar.

2.3 Input

The input section shall define the data to be used for the survey. It is necessary to establish design parameters as the distance between the source of the outbreak (shot, explosion) and the axis of the hole, the number of records received (parameters) and the position of the first measurement. If it is specified a fixed spacing between the measurements, the program automatically calculates the depth of each recording. The depth and the travel time between the source and receiver for the P and also for the S waves must be entered for each test. This data can be entered manually or extracted from SEG2 files.

It is possible to use copy and paste commands to make more versatile the operation of data entry. Finally, by right clicking on the drawing, you can insert a custom description for the project

2.4 Output

This section summarizes all the data processed.

It is possible to choose the type of examination to be made, between the options of calculation with the direct method or interval method. In the first case it will be summarized in the grids at the bottom only the values of $T_{p_{cor}}$ and $T_{s_{cor}}$, in second case it will also be available the values of wave velocities, the unit weight, Poisson's ratio, shear deformation modulus, the oedometric compressibility module, Young's modulus and bulk modulus for each intervals of measurement. By right clicking on the travel time graph it can be defined a custom seismic stratigraphy assigning the depth of the layer. The depth can be varied by adjusting the chart. The data relating the seismic stratigraphy can be customized by adjusting the chart directly. These are summarized in a special grid on the bottom of the workspace. Next to each seismic layer are summarized seismic data as average values of v_p , v_s , g , n_i , G , E_d , E , E_v . If you chose the interval method system of calculation it can be assigned a seismic stratigraphy also from the speed profile range, which is activated by pressing the menu above the chart.

3 SEG2 file import

This section of the program allows to extract the experimental data on arrival times of P and S waves contained in the SEG2 files.

The preliminary phase consists in defining for each depth of investigation the three files containing the data to be processed.

▣ Notes:

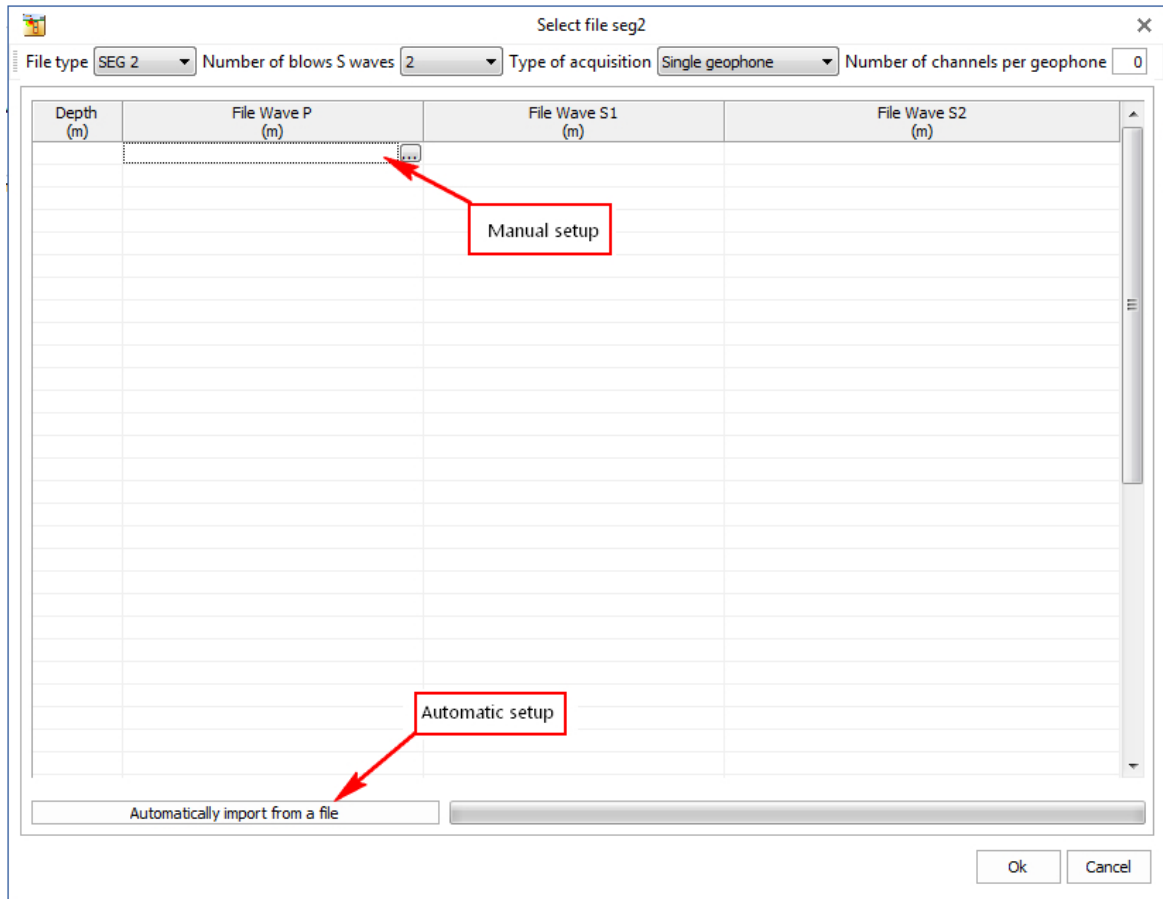
To start again the extraction saved in a work file it is not necessary to follow this operations

SEG2, Ambrogeo, drm

Information can be entered manually or it can be used an automatic import of all files from a folder specified by the user. In this case, the files are loaded in groups of three in alphabetical order, using the following convention:

- the first file is associated with P wave
- the second is associated with S1 wave
- the third is associated with S2 wave.

It can be then specified the depth intended for the uploaded files.



Txt, CSV

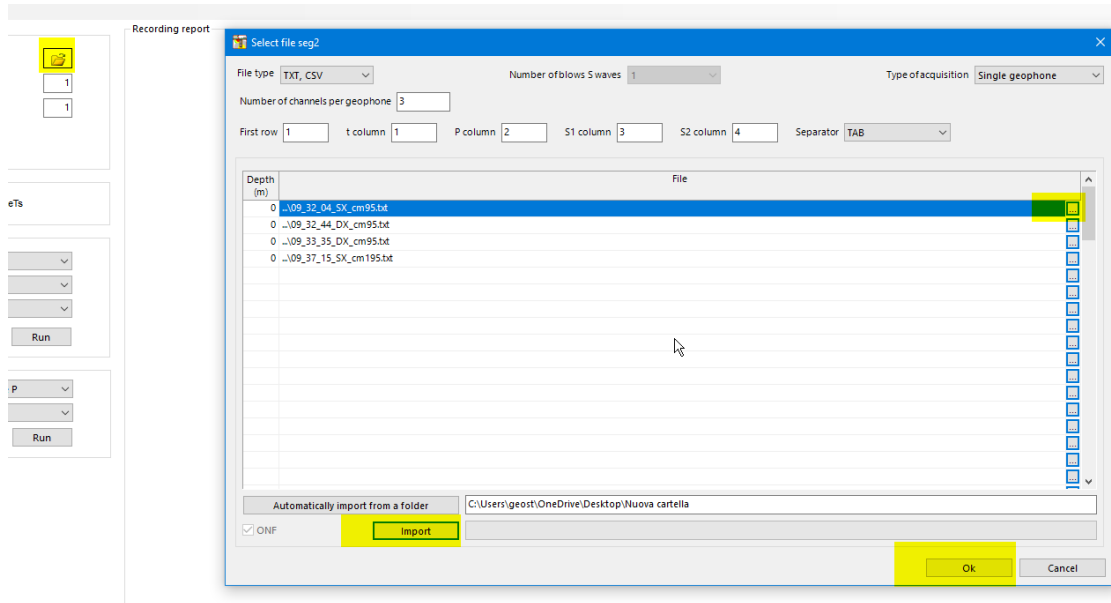
In the import window it is possible to insert a text file for each depth. Files can be selected individually by clicking on the button in the corresponding grid cell, or by selecting a folder using the button below the grid and then clicking on "import".

This file must contain 4 columns.

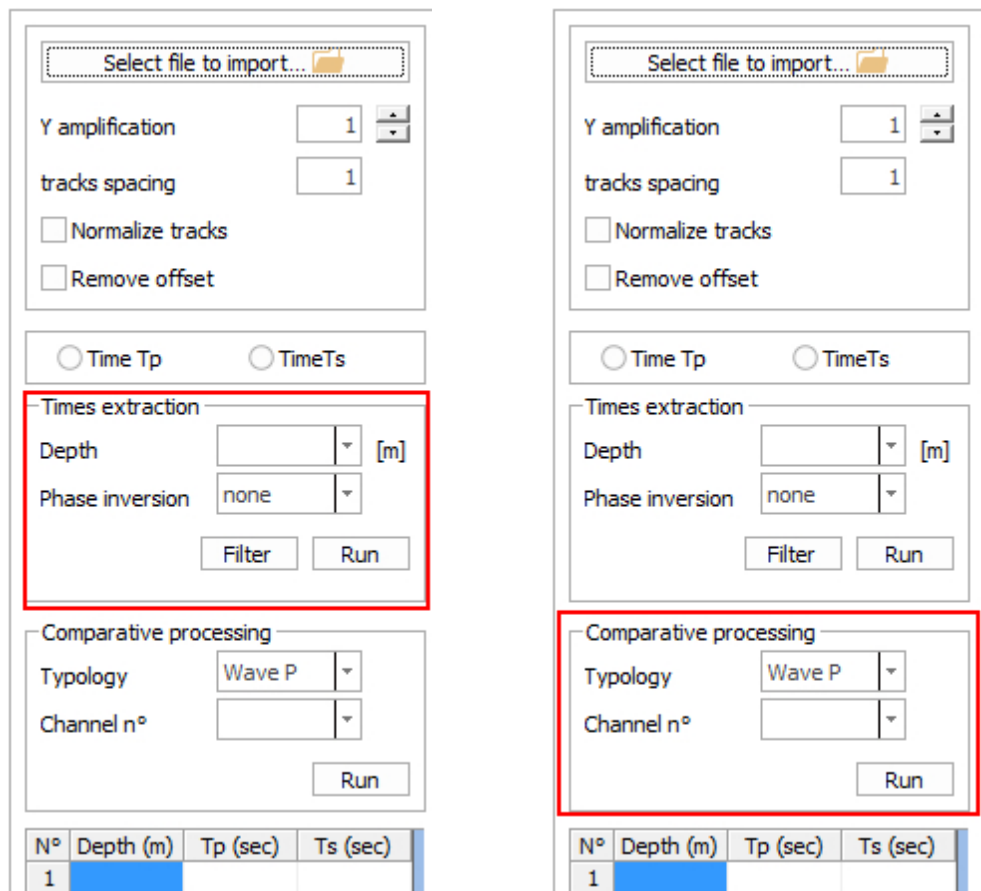
- The column of time values
- The column of values relating to P
- The column of values relating to S1
- The column of values relating to S2

After setting the correct file type (txt/csv), four boxes are displayed in which you can specify the first row of values, the various columns and the type of separator.

NB: The files must, of course, have the same number of rows and the same arrangement of columns.

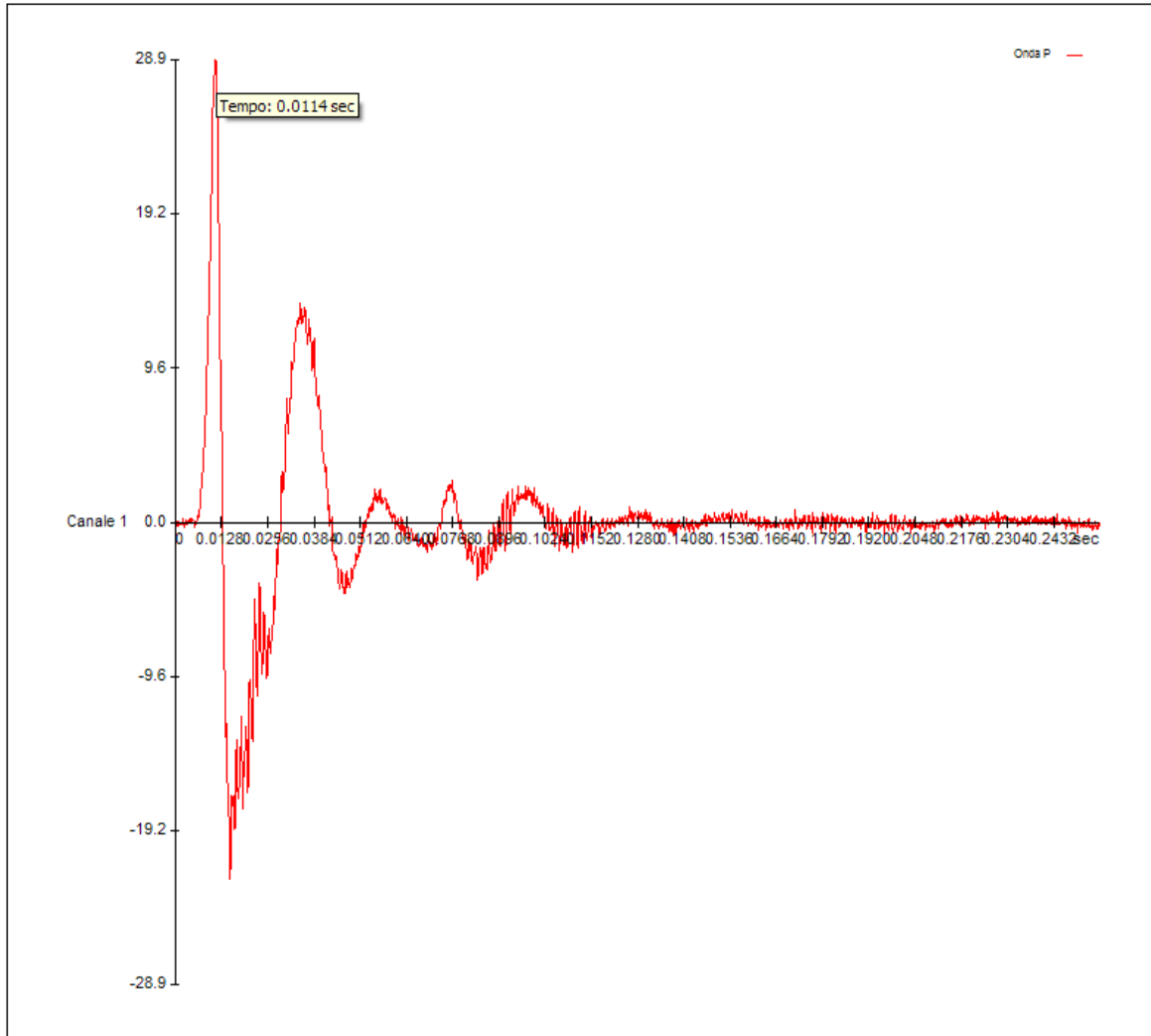


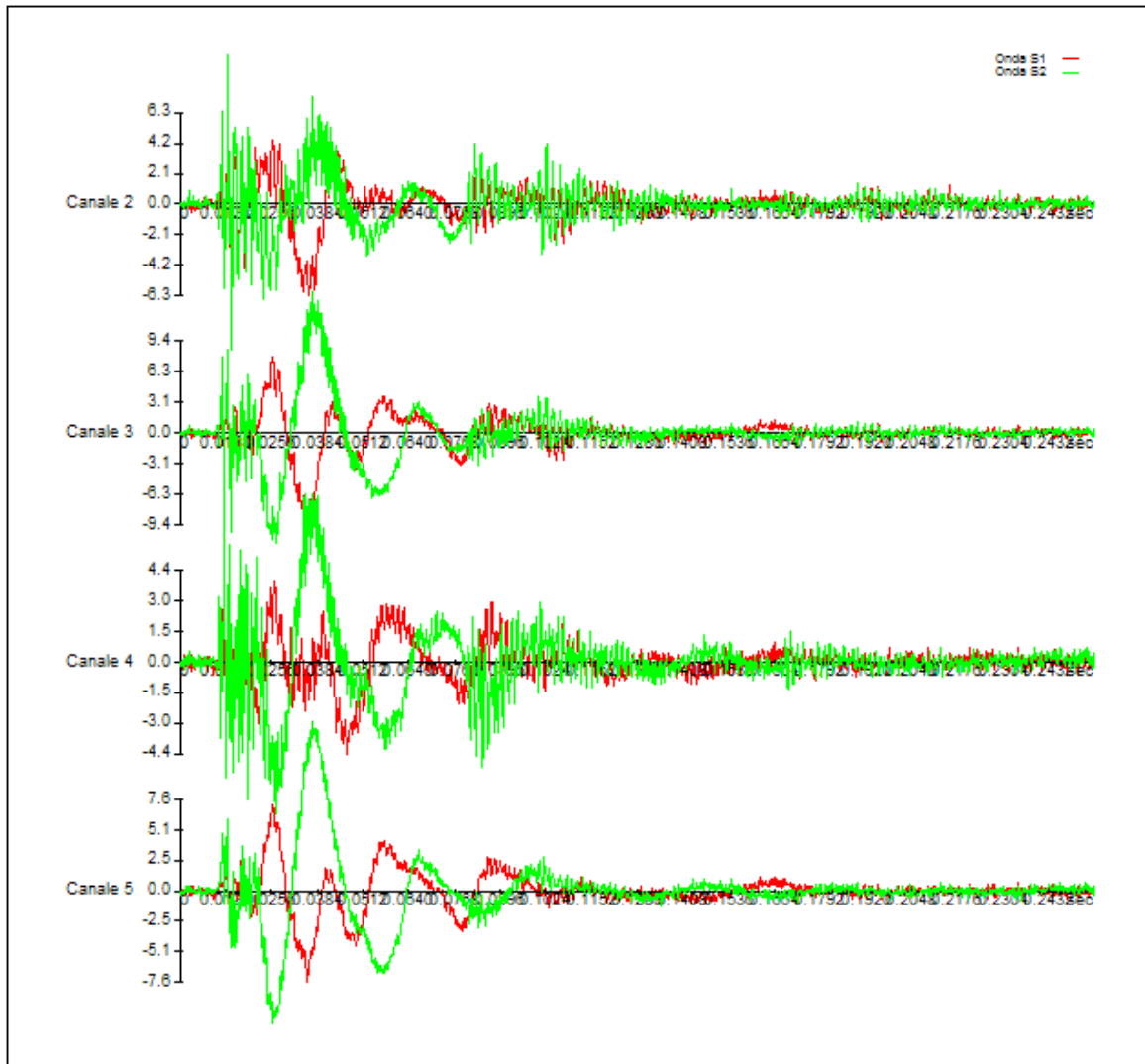
The extraction can be separately done for the P waves and S waves at each reference depth, or it can be viewed all the waves of the same type referred to a particular channel.

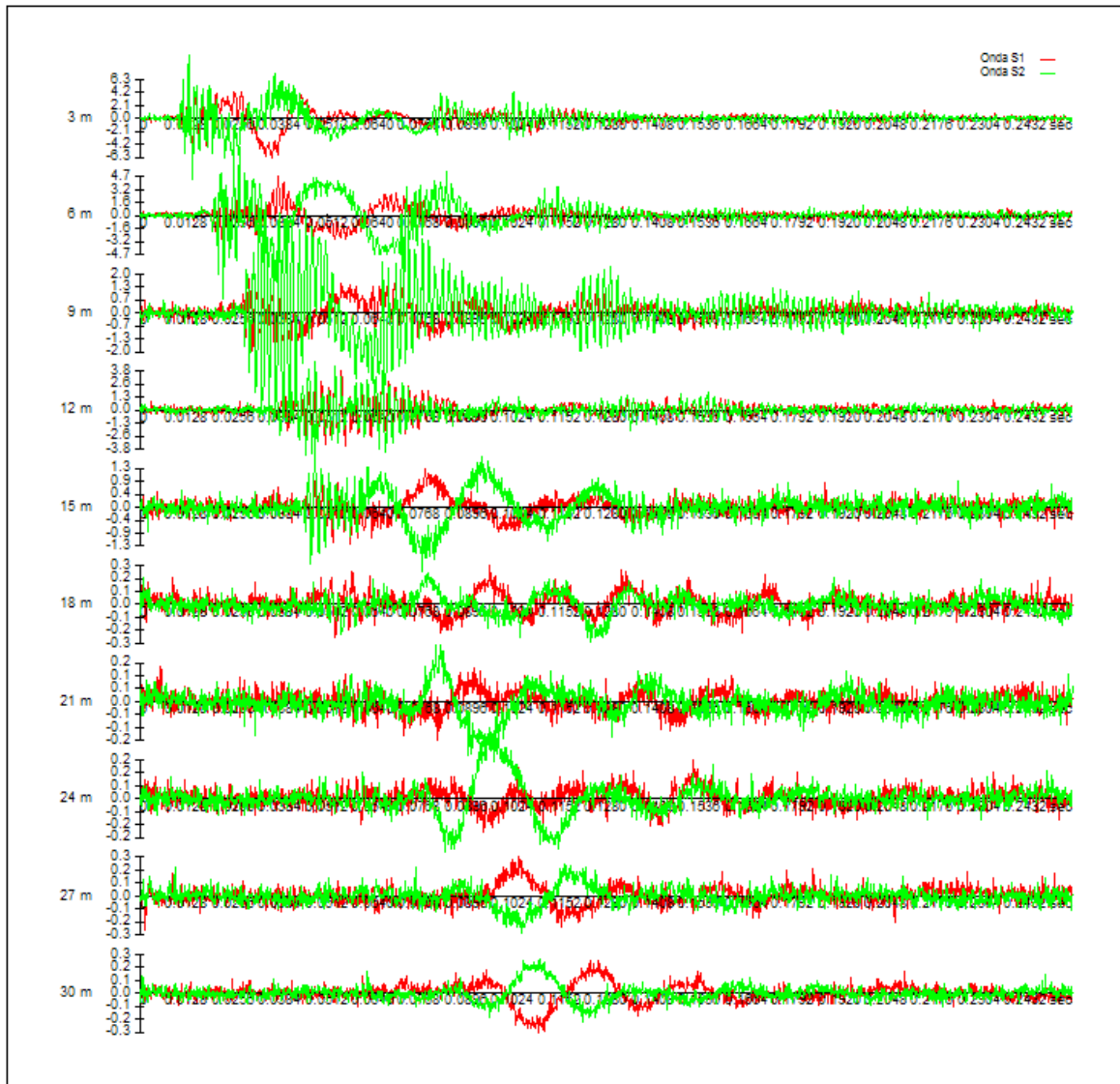


In the first case it should be specified the depth at which is conducting the investigation and the type of extraction to be performed. For the analysis of time T_p is analyzed only the diagram P wave for the appropriate file, while for the time T_s are drawn the left side and right side S waves for each acquisition channel of the geophone. S waves appear superimposed to allow the user to easily locate the point of phase inversion. This type of extraction can also be done by choosing to reverse the S1 or S2 waves. In this case is also determined the sum of the two tracks. During the graphical analysis, the value of time corresponding to mouse position on the drawing can be observed. In order to select the time to use in the project is simply to right click in corresponding to the desired value and choose the "Select Time" option in the menu. A window will make possible to improve the selection by including the reference measurement for that acquisition.

If is intended to do a comparative analysis it is possible to choose to track all the waves of the same channel choosing between P wave, S1 wave, S2 wave, or S1 wave and S2 wave superposed.







The Advanced menu provides detailed information on seg2 file, with details relating to the instruments or to individual tracks. From this menu can be excluded channels that should not be considered to determine the arrival times T_s .

Selections are collected in tabular form at the left of the window.

At the end of the study the "Export" command from the "File" menu makes available the data collected for processing. These, in fact, are inset into the "Input data" of the main program. In a dual manner, you can import data using the main program command "Import."

4 Geoapp

Geoapp: the largest web suite for online calculations

The applications present in Geostru Geoapp were created to support the worker for the solution of multiple professional cases.

Geoapp includes over 40 applications for: Engineering, Geology, Geophysics, Hydrology and Hydraulics.

Most of the applications are **free**, others require a monthly or annual **subscription**.

Having a subscription means:

- access to the apps from everywhere and every device;
- saving files in cloud and locally;
- reopening files for further elaborations;
- generating prints and graphics;
- notifications about new apps and their inclusion in your subscription;
- access to the newest versions and features;
- support service through Tickets. Enter topic text here.

4.1 Geoapp Section

General and Engineering, Geotechnics and Geology

Among the applications present, a wide range can be used for **DownHole**. For this purpose, the following applications are recommended:

- > Sismogenetic zone
- > Soil classification SMC

> Seismic parameters

5 Recommended books

Geotechnical, engineering, and geology books

Portal books: explore the library

- **Methods for estimating the geotechnical properties of the soil**

Methods for estimating the geotechnical properties of the soil: semi-empirical correlations of geotechnical parameters based on in-situ soil tests.

This text is designed for all professionals who operate in the geotechnical subsurface investigation. The purpose of this text is to provide an easy reference tool relatively to the means available today.

Theoretical insights have been avoided, for which please refer to the bibliography attached, except in cases where these were considered essential for the understanding of the formulation. The reason for this is obvious: make the text as easy to read as possible.

After a brief introduction about volumetric and density relationships with the most common definitions used for soils, in the following chapters we briefly described some of the most widespread in situ geotechnical testing and correlations to derive empirically geotechnical parameters and a number of useful formulations available today in the field of Geology.

The text concludes with the inclusion of formulas used in Technical Geology, considered of daily use to those working in the sector.

The topics are intended to provide a basic understanding of the in situ geotechnical testing and evaluation of geotechnical parameters necessary to define the geotechnical model.

