Trispace

1 GeoStru Software

1.1 Initial Page

The **GeoStru Software** company develops technical and professional software for engineering, geotechnics, 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 five languages – is compatible with international computation rules / normatives and it is one of the most used in over 50 countries worldwide.
GeStru is always present at the main exhibitions in the field, both in Italy - SAIE Bologna, GeoFluid Piacenza and Europe - SEEBE Belgrade, Construct Expo Bucharest, 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.com/

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.

1.2 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-2012._._._), 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.''

1.3 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.
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1.4 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.com

1.5 Contact

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

1.6 Utility

1.6.1 Conversion Tables

Inclination (%)	Angle (°)		Inclination (%)	Angle (°)

1	0.5729		26	14.5742
2	1.1458		27	15.1096
3	1.7184		28	15.6422
4	2.2906		29	16.1722
5	2.8624		30	16.6992
6	3.4336		31	17.2234
7	4.0042		32	17.7447
8	4.5739		33	18.2629
9	5.1428		34	18.7780
10	5.7106		35	19.2900
11	6.2773		36	19.7989
12	6.8428		37	20.3045
13	7.4069		38	20.8068
14	7.9696		39	21.3058
15	8.5308		40	21.8014
16	9.0903		41	22.2936
17	9.6480		42	22.7824
18	10.2040		43	23.2677
19	10.7580		44	23.7495
20	11.3099		45	24.2277
21	11.8598		46	24.7024
22	12.4074		47	25.1735
23	12.9528		48	25.6410
24	13.4957		49	26.1049
25	14.0362		50	26.5651

Converting slope inclination in degrees

From	To	Operation	Factor
N	kg	Divide by	9.8
kN	kg	Multiply by	102
kN	Tonn	Divide by	9.8
kg	N	Multiply by	9.8
kg	kN	Divide by	102
Tonn	kN	Multiply by	9.8

Forces conversion: 1 Newton (N) = 1/9.81 Kg = 0.102 Kg ; 1 kN = 1000 N

From	To	Operation	Factor
Tonn/m²	kg/cm²	Divide by	10
kg/m²	kg/cm²	Divide by	10000
Pa	kg/cm²	Divide by	98000
kPa	kg/cm²	Divide by	98
Mpa	kg/cm²	Multiply by	10.2
kPa	kg/m²	Multiply by	102
Mpa	kg/m²	Multiply by	102000

Pressures conversion: 1 Pascal (Pa) = 1 Newton/mq ; 1 kPa = 1000 Pa; 1 MPa = 1000000 Pa = 1000 kPa

1.6.2 Database of soil physical characteristics

Soil	Minimum value	Maximum value
Loose sand	0.48	1.60
Average compact sand	0.96	8.00
Compact sand	6.40	12.80

Soil	Minimum value	Maximum value
Average compact clayey sand	2.40	4.80
Average compact silty sand	2.40	4.80
Compact sand and gravel	10.00	30.00
Calyey soil with qu< 2 Kg/cm²	1.20	2.40
Calyey soil with 2< qu< 4 Kg/cm²	2.20	4.80
Calyey soil with qu> 2 Kg/cm²	>4.80	

Approximate values of Winkler's constant K in Kg/cm3

Soil	Minimum value	Maximum value
Dry gravel	1800	2000
Wet gravel	1900	2100
Compact dry sand	1700	2000
Compact wet sand	1900	2100
Loose dry sand	1500	1800
Loose wet sand	1600	1900
Sandy clay	1800	2200
Hard clay	2000	2100
Semisolid clay	1900	1950
Soft clay	1800	1850
Peat	1000	1100

Approximate values of the volume weight in Kg/cm3

Soil	Minimum value	Maximum value
Compact gravel	35	35
Loose gravel	34	35
Compact sand	35	45
Loose sand	25	35
Sandy marl	22	29
Fat marl	16	22
Fat clay	0	30
Sandy clay	16	28
Silt	20	27

Approximate values of the friction angle j, in degrees, for soils

Soil	Value
Sandy clay	0.20
Soft clay	0.10
Plastic clay	0.25
Semisolid clay	0.50
Solid clay	1
Tenacious clay	2÷10
Compact silt	0.10

Approximate values of cohesion in Kg/cm2

Soil	Maximum value of E	Minimum value of E
Very soft clay	153	20.4
Soft clay	255	51
Medium clay	510	153
Hard clay	1020	510
Sandy clay	2550	255
Loess	612	153
Silty sand	204	51

Soil	Maximum value of E	Minimum value of E
Loose sand	255	102
Compact sand	816	510
Clayey schist	51000	1530
Silt	204	20.4
Loose sand and gravel	1530	510
Compact sand and gravel	2040	1020

Approximate values of the elastic module, in Kg/cm2, for soils

Soil	Maximum value of ν	Minimum value of ν
Saturated clay	0.5	0.4
Not saturated clay	0.3	0.1
Sandy clay	0.3	0.2
Silt	0.35	0.3
Sand	1.0	-0.1
Gravelly sand commonly used	0.4	0.3
Loess	0.3	0.1
Ice	0.36	
Concrete	0.15	

Approximate values of the Poisson's ratio for soils

Rock	Minimum value	Maximum value
Pumice	500	1100
Volcanic tuff	1100	1750
Tufaceous limestone	1120	2000
Coarse sand dry	1400	1500
Fine dry sand	1400	1600
Wet fine sand	1900	2000
Sandstone	1800	2700
Dry clay	2000	2250
Soft limestone	2000	2400
Travertine	2200	2500
Dolomite	2300	2850
Compact limestone	2400	2700
Trachyte	2400	2800
Porphyry	2450	2700
Gneiss	2500	2700
Serpentine	2500	2750
Granite	2550	2900
Marble	2700	2750
Syenite	2700	3000
Diorite	2750	3000
Basalt	2750	3100

Approximate values of specific weight for some rocks in Kg/m3

Rock	Minimum value	Maximum value
Granite	45	60
Dolerite	55	60
Basalt	50	55
Sandstone	35	50
Calyey schist	15	30
Limestone	35	50
Quartzite	50	60
Marble	35	50

Approximate values of the friction angle j, in degrees, for rocks

Rock	E		ν	
	Maximum value	Minimum value	Maximum value	Minimum value
Basalt	1071000	178500	0.32	0.27
Granite	856800	142800	0.30	0.26
Crystalline schist	856800	71400	0.22	0.18
Limestone	1071000	214200	0.45	0.24
Porous limestone	856800	35700	0.45	0.35
Sandstone	428400	35700	0.45	0.20
Calyey schist	214200	35700	0.45	0.25
Concrete	Variable		0.15	

Approximate values of the elastic module and Poisson's ratio for rocks

1.7 Shortcut commands

File	
Ctrl + N	New
Ctrl + F12	Open
Caps Lock + F12	Save
F12	Save as
Ctrl + Caps Lock + F12	Print

Select / modify	
Ctrl + A	Select all
Ctrl + M	Measure distance
Del	Delete
Ctrl + Z	Undo
Ctrl + Y	Redo
Ctrl + X	Cut
Ctrl + C	Copy
Ctrl + V	Paste

View	
Z	Zoom all
Alt + Z	Zoom window
R	Rotate
Page up	Level up
Page down	Level down

Panels	
Alt + Q	Hide panel
Alt + L	Open level panel
Alt + X	Open DXF/DWG panel
Alt + S	Open Sections panel
Alt + M	Open Materials panes
Alt + C	Open Loads Panel
Alt + K	Open Nodes panel

Panels	
Alt + O	Open Options panel
Alt + P	Open Properties panel

Other commands	
Ctrl + S	Save image
F5	Calculate

2 Introduction

2.1 Trispace

Defines and elaborates on more layered surfaces. It offers the possibility to obtain autonomous triangulations of each layer, which can subsequently be put into relation with them to calculate volume, offsets, excavations, etc.
It also offers 3D viewing of single surveys or complete layers, and axis selection on a visual plane(X,Y,Z).
It provides the insertion of point coordinates from the keyboard, with the possibility to indicate additional attributes, such as the symbol, the colour, if it is a detailed generic point, a fiducial/station point or penetrometric drilling.
In the latter case, it is possible to specify more depth quote for the same planimetric coordinate.
Trispace also makes it possible to import survey points from different formatted files: Autocad, DXF, formatted texts, excel.
It also offers standard graphic objects, such as texts, lines, polylines, archs, polygons, and rectangles.
Other important features are:

- Duplicate analyses;
- Guided point decimation;
- Standard precision tools (SNAPs and guild grids);
- Importation of scaled bitmap images(raster graphics);
- ASCII importation with general formats.

2.2 Triangulations/Surfaces

- Point triangulation with the possibility to indicate resistance lines, perimeters, or excluded areas(for lakes,ditches, etc);
- Automatic triangulation of survey points' movement;
- The obtainment of a contour line with personalized labelling;
- Wide choice of colouring shades to highlight the layer quote.

2.3 Interpolations

- The obtainment of Isozone;
- An editable Voronoi diagram;
- Kriging;
- Linear and cubic interpolation (using estimations and approximations);
- Levellings with a horizontal plane;
- Levelling with a plane through three points;
- Levelling between two surveys;
- Excavation simulations;
- It is possible to define buildings in 3D.

2.4 Sections

- Longitudinal section is directly on a arbitrary polyline base;
- Longitudinal section for point combination;
- Automatic equidistant sections;
- Tridimensional section with interpolation of more surveys with different quote.

3 Calculation and control tools summary

3.1 Quota Exchange

This allows the quota modification of all the survey points, based on a variation of a known point.

3.2 Coordinate Inversion

This allows the coordinates to be inverted in relation to a known axis and the distance from the axis.

3.3 Verify Constraints

Once the constraints are inserted into the survey, this function then allows the possibility to first determine the validity in order to perform the final triangulation. The constraints' application rules entail other criterias:

- No line can intersect another;
- There shouldn't be any double lines;
- The lines can have coincidental vertices on the survey points, but they can't have aligned points on the same line.

3.4 Capture triangular points

This function draws possible new points derived from triangulations, refinements, interpolation. The new points capture completely substitutes the original set. All of the obtained data is a "detailed" type and is associated with the "Points" layer.

3.5 Distance

This allows the drawing of a temporary polyline to verify the progressive distances, totals, planimetrics and 3D.

3.6 Duplicate points control

This allows the verification of double points if they are present on survey. The tolerance value is specified in the section control panel. "Survey points" ->"Double points tolerance". The window will cause a display

result which will show individual points as double points. Although possible, It is wisely recommended that you not run triangulations when double points are present.

3.7 Double points decimation

As in the previous function, with the dfference that it deletes them from the survey. There are two calculation modes: Leaving the first individual point or running the average, personalizable from the control panel section " Survey points" ->"Decimation mode".

3.8 Offset

Running the offset (equidistant) of a polyline or a polygon. The offset value (indicated in the input window) applied to a polyline produces a polygon with a thickness equal to the specified offset. Applied to a polygon keeping another polygon around the same offset thickness.

3.9 Add node

Add node and a polyline or polygon to the position indicated by the mouse.

3.10 Remove node

Delete a polyline or a polygon vertex.

3.11 3D Plane Alignment

Consists in the calculation of the of the survey points quota from the average plane. For example, we know that it is a surveyed plane(horizontal or inclined),and this function allows you to graphically verify the possible imperfect measurement. In the 3D preview window

displayed in the calculated plane, the split in blue highlights the positive quote and the red one highlights the negative quote. At the end of the process, the program ask if you would like to save the results on the current survey. This option should allow, a once duplicate of the original survey., to compare the differences between the due numerical models(with the Compare measurements), to calculate the excavation and report(use the intersection function between the two DTM)

Algorithm use:

- *Least squares;*
- *best fit plane check.*

3.12 Compare measurements

This functions allows the verification of two numerical models highlighted in the tolerance discard, being on a data grid(exportable or printable) graphically .

See also: *3D plane alignment*

3.13 Convert Isolines -> Polylines

The isolines o curve of the survey produced by the software are not modifiable by the user as a simple polyline, and they are associated exclusively to the current DTM. This functions allows the conversion of the isolines into normal polylines. At this point it is possible to control the graphic characteristic or the geometrical data, and their visibility will extend to all the DTM in the project.

3.14 Mouse click on survey points

Constrains the insertion of nodes(for example, a polyline)on survey points. It is useful in defining the constraints, which do not allow the indicating of vertices that are not coincidental to points.

3.15 Find point

This allows the indication of point name and to single them out on the drawing.

3.16 Calculate the convex perimeter

This functions automatically keeps the convex perimeter of a pointed survey. The polygon can be successfully modified to be used as a constraint perimeter for the triangulation.

3.17 Calculate the concave perimeter

This function is available only during triangulation, it generates a polygon that runs the triangulation perimeter profile. It is useful to add and remove triangles from a model or wish to calculate the perimeter or area quickly.

3.18 Triangulation/ Rotrotralation

This allows the processed movements of the survey points in a parametric mode. Notice that the calculation doesn't influence the triangulation but also the survey points.

3.19 Delete external triangles

This functions result is useful is for example the intersection has to be calculated and the volumes between the two models that have result similar to the biggest part of the surface. So the total calculation works to limit process times, less triangles must be taken into consideration, more velocity will be the final result. Functions on the polygon base introduced by the user, deleting all the triangles that are completely external and itself.

3.20 Level and Divide

It requires a quota from the user and using a horizontal plane, it separates the current model into two new DTM(one superior and one inferior).

3.21 Merge surveys

Numerical models unification. Display the available DTM list in the project and combine all the sections of the current survey.

3.22 Line redimension

Given a selected polyline, it requires the new length, deleting the extending vertices or prolonging the last split.

3.23 Restrict polygon

Similar to offset, it restricts polygon thickness indicated by user

3.24 Dynamic Labels

This allows for line drawing with the mouse and all intersections with an isoline (base curve) placing a quota label.

3.25 Triangular

Runs a triangulation of the survey points and obtains a homogenous surface of the adjacent triangles and not the overlapped.

Algorithm use:

- *delaunay;*
- *constrained delaunay triangulation;*
- *incremental delaunay triangulation;*
- *Ruppert's mesh refinement anisotropic triangulation.*

3.26 Isolines / Contour line

Obtain crossing lines by an equidistant quote, used to draw the height difference of a surface.

3.27 Isozone

Like as the Isolines, the isozone splits the surface by an equidistant quote. It is possible to obtain singular numerical models for ever isozone o only global model.

3.28 Voronoi

Calculate the vertices and the voronoi sites. Gives a triangulation, this algorithm calculates the triangle centre and in relation to the nearby triangles, keeps the maximum usable area. To understand what it is and why we need it, just imagine the territorial provinces of Holland and know that Holland's territorial administrators have been divided the state based on this type of classification. The provinces centres were taken as vertices for triangulation, and the area results(Voronoi sites) correspond to the maximum extensive geographic.

3.29 Levelling with horizontal plane

Gives a calculated plan quota of a the volume, excavation and report of a numerical number.

3.30 Levelling with an inclined plane (or through three points)

Calculate the volume, the excavation and report based on the definite plane between three known points.

3.31 Intersection between two numerical numbers

Calculate the volume, excavation and report based on the two different numerical models

3.32 Map Image

This function shades the surface with the current coloration to be exported in bitmap and is eventually applied to the 3D display come texture.

3.33 Excavation

This functions to cut the triangled suface. The incision can run surface profile at a prefixed depth, or have a flat base at a pre-set quota. In the road approximation it is possible to indicate the edge width and the road depth

4 How to identify the basin using Trispace

How to identify the basin using Trispace

TRISPACE also allows reading in a direct way the SRTM files: from the *File/Open* menu, select the .srtm file in the openings filter.

Procedure

Execute the triangulation and trace out the slope vectors from the Elabora/Work out menu.

On the basis of the slope vectors, trace out the polygon which identifies the basin clockwise using the polygon tool.

Trace out the main river pole from uphill to downhill using the polyline tool: this setting is significant to establish the direction of the water flow in Hydrologic Risk.

From the Elabora/Work out menu, select the Crea bacino idrografico/Create catchment basin control: a file in ASCII format to be imported to Hydrologik will be created.

5 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 throught Tickets.

5.1 Geoapp Section

General and Engineering, Geotechnics and Geology

Among the applications present, a wide range can be used for **Trispace**.

For this purpose, the following applications are recommended:

- GeoStru maps
- SRTM
- Wedge 3D

6 Import of catchment basins from SRTM

The **SRTM** application allows creating the digital model of the ground in an area of interest identifiable through a selection box made up 4 pointes (the vertices of a rectangle).

The ASCII file generated by SRTM contains the coordinates x, y and z, separated by ";", relevant to the pints included in the area under examination.
The ASCII file can be worked out using specially dedicated programmes, such as TRISPACE, in order to obtain relief maps, contour lines, sections, etc.

TRISPACE allows importing the file worked out by SRTM, with Importa file dati/Import data file control from the Dati/Data menu.
The imported file only contains the coordinates of the points: the identification of the basin must consequently be carried out manually.