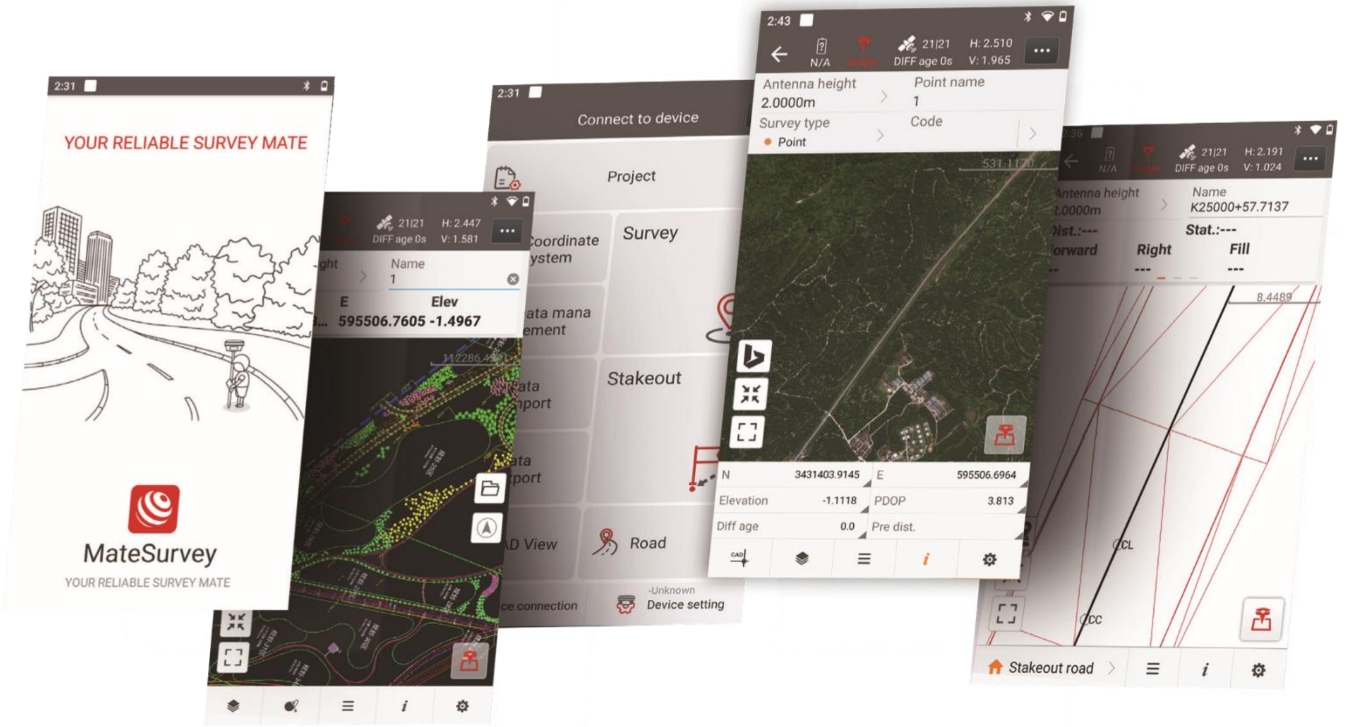
GEOMATE MateSurvey

User Guide



Version 2.0
June 2023

Premium Surveying. Trusted Solutions

Warning

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1 Contents

1 MateSurvey Overview

1.1 Software Description

MateSurvey is an Android-based GNSS field data collection software designed to provide users with efficient and convenient surveying and stakeout. MateSurvey software features a distributed architecture that fully utilizes the convenience of the Internet, bringing a new operational experience to survey crews in the field. The integrated cloud service greatly simplifies data transfer between the surveyor's field controller and project supervisors in the office, and more. DXF and DWG project files are fully supported by MateSurvey and users can directly stake out points or lines from the original design drawings.

1.2 Key Features

One-button Switching Dual Styles

- Simple Style, designed for the entry-level surveyors, with all basic function in one screen.
- Classic Style, designed for professional surveyors, with more functions showing in different tables based on the frequently-used work flow.

Various Base Map Displays

- OSM, BING, Google Image, WMS, V-World, Geoportal online maps.
- DXF(including 3D DXF), SHP, TIF, SIT, KML, KMZ offline maps
- JPG

Extensive Import and Export Data Formats

- Import from DXF(including 3D DXF), SHP, KML, KMZ, JPG, CSV, DAT, XLSX, TXT, TIFF and MBTILES.
- Export to DXF, SHP, KML, KMZ, RAW, HTML, CSV, DAT, TXT, XLSX formats.
- Customized import and export contents in CSV, DAT or TXT formats.

Various Types of Measurement

- Supports static, RTK and stop & go measurement.

- 7 methods of point measurement, including topographic point, control point, quick point, continuous point, offset point, EBubble compensated point and corner point.

- Simultaneous stop-and-go and RTK measurement using topographic point or continuous point.

Various Peripherals Supported

- Pipeline detector, VIVAX-METROTECH vLocPro2.

- Laser rangefinder, Leica Disto 810 touch, Disto 510 touch, and SNDWay SW-S120C.

Convenient Work Mode Management

- Presetting common work modes of base and rover, selecting or switching work modes by one button.

- Convenient to work in stop&go based on real-time kinematic (RTK) mode and static mode can be set at the same time.

Standard CGD Correction File

- Multiple grid formats are avaliable, GGF, BIN, GRT DAT, DATCZ, GRD, GSF, GRI, STG, GBL, GXY, OSGB, JASC, GSA, GSB, BYN, GTX, NEGRID, TXT and ASC formats.

User-friendly Stakeout Interface

- Two modes for stakeout, map mode shows the current position and target position, compass mode shows the target direction.

- Users can set North, Sun or point as a reference direction.

Multiple Types of Stakeout

- Point and line stakeout by snapping feature point on DXF base map or survey point.

- Surface and road stakeout.

Correction Repeater Function

- Easily repeating correction data from RTK network or radio mode to other rovers via radio.

RTCM Transformation Message

- Using RTCM transformation messages (1021-1027) for datum transformation, projection, automated grid position and geoid adjustments.

Base Map rotates

- Base map rotates with the direction of the PDA during the surveying process.

1.3 Devices Support

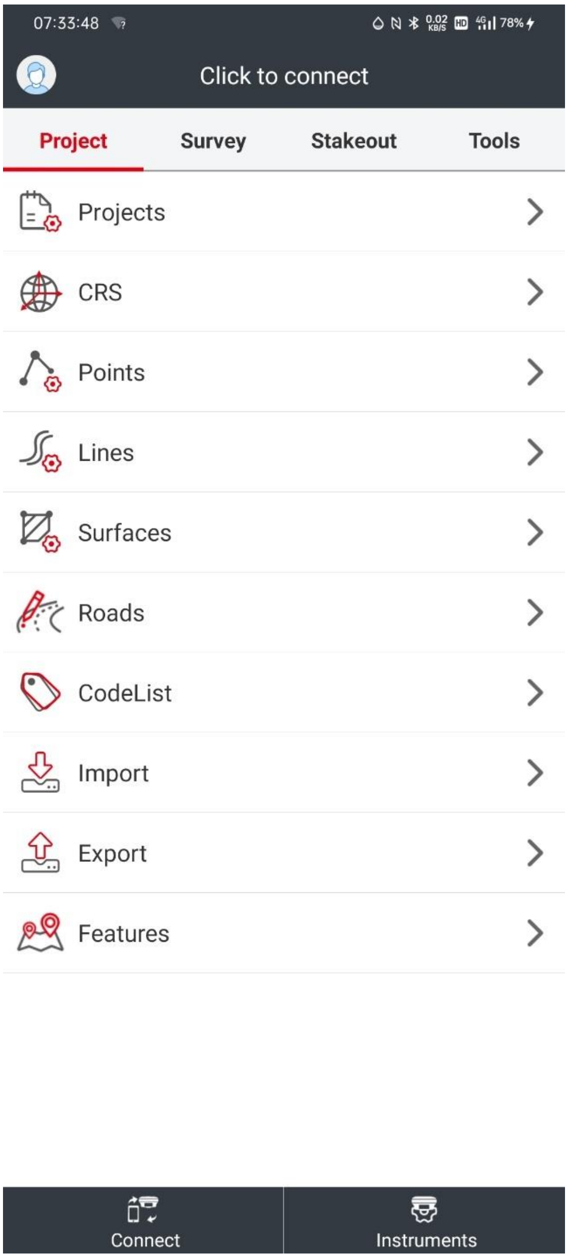
Device	Type	Note
GeoMate SG5	GNSS geodetic receiver	
GeoMate SG7	GNSS geodetic receiver	
Android Smartphone or handheld controller	With Internal GPS	Android version 4.2 and above
VIVAX-METROTECH vLocPro2	Pipeline Detector	-
Leica Disto 810 touch	Laser Rangefinder	-
Leica Disto 510 touch	Laser Rangefinder	-
SNDWay	Laser Rangefinder	-
Bosch	Laser Rangefinder	

1.4 Software Interface

Starting from MateSurvey 2.0, the interfaces has two styles: **List style** and **Classic style.**

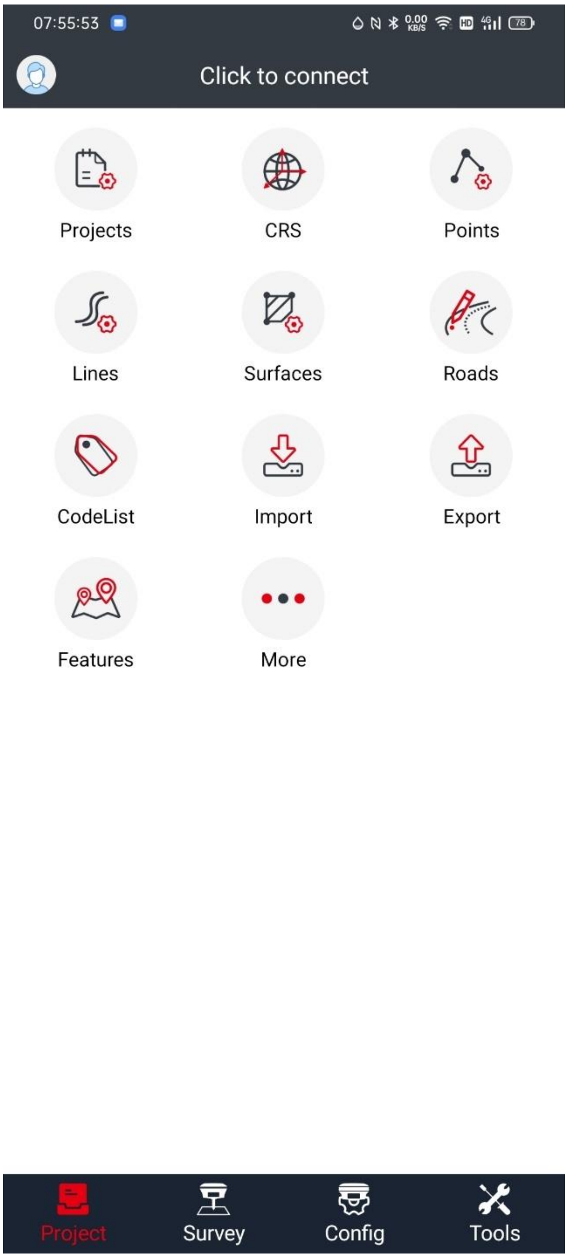
Startup Interface: Install at the first time and run the software can directly into the main interface.

In **List Style**, all the functions are listed in list style. It consists of four parts: Project, Survey, Stakeout and Tools.



In **Classic Style**, all the functions are listed in circular icons. It is made up of four parts: **Project**, **Survey**, **Config** and **Tools**.

GEOMATE



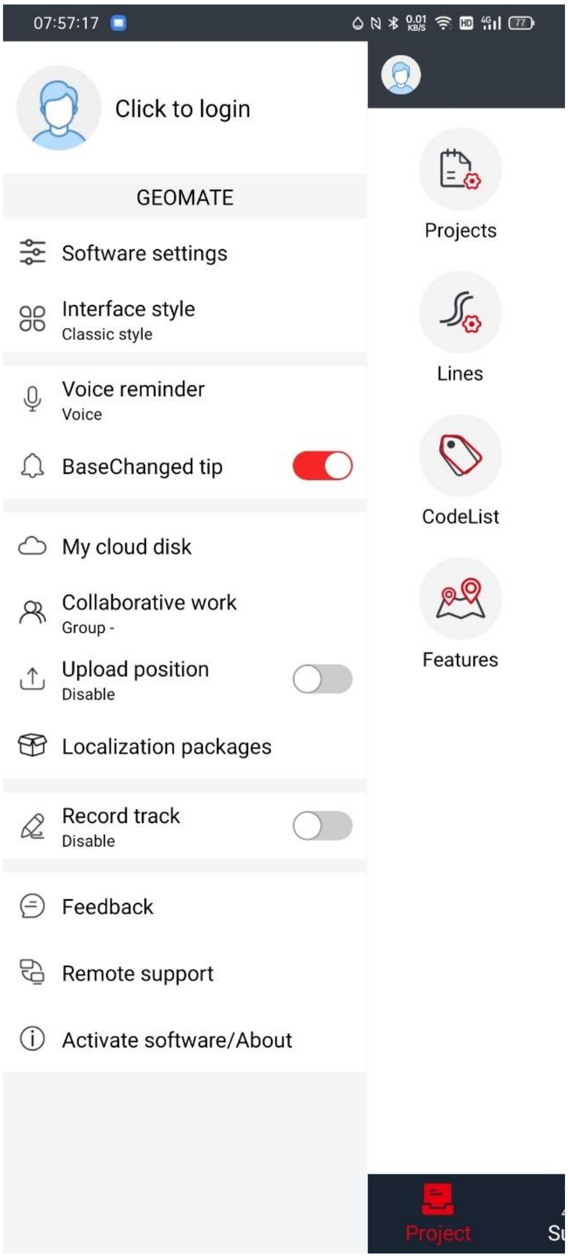
1.5 Registry

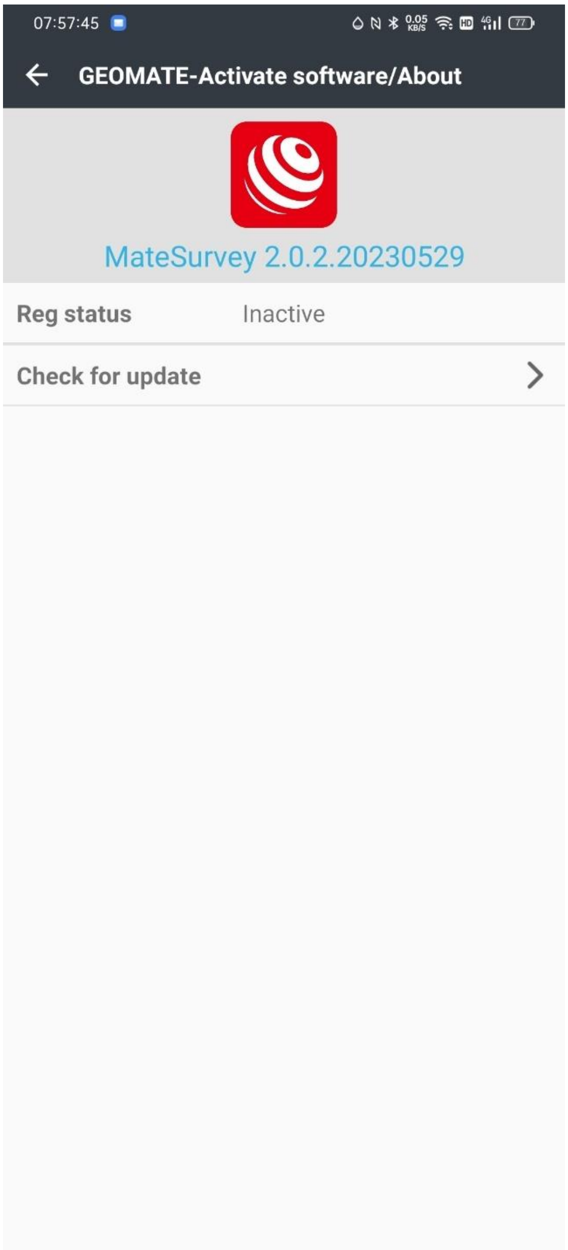
If the software is not registered, please contact regional sales representative.

Register:

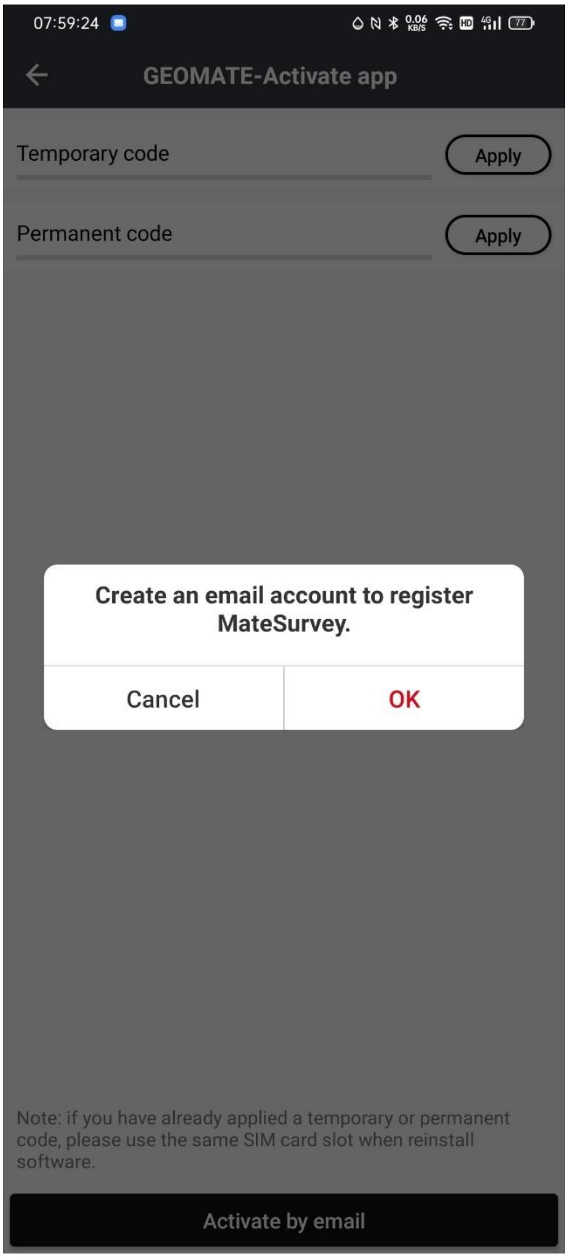
(1) **Register via Email**

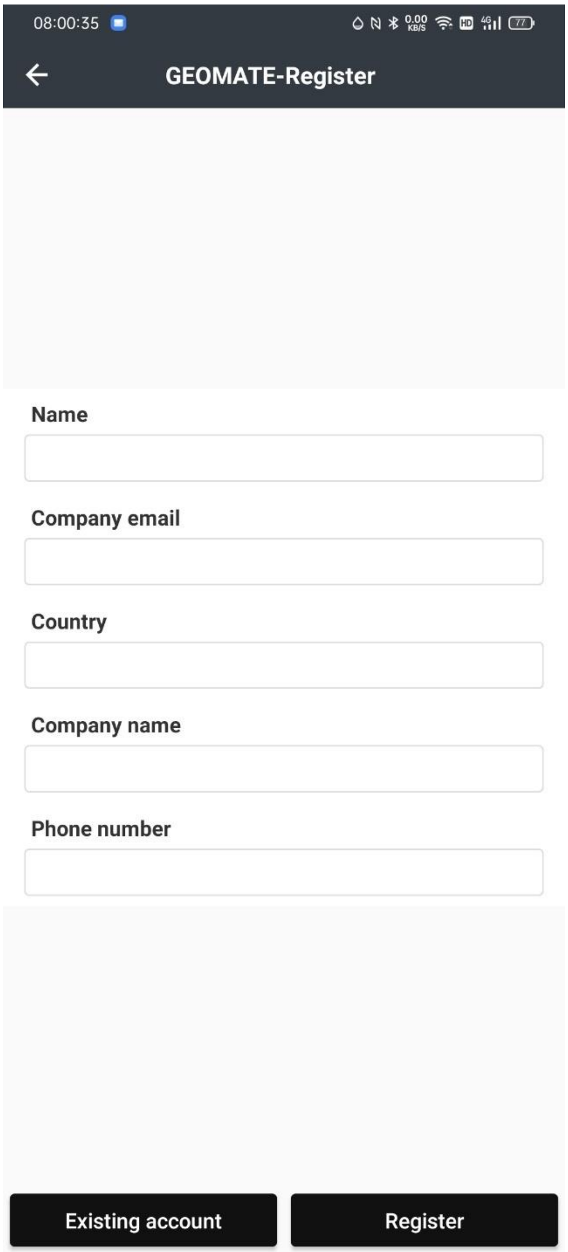
Enter the **Slide menu** interface and click **Activate software/About**. Users will see register status is **Inactive**, click **Inactive**. Then users will see a pop-up window: "Enter an email address before activating the software.", click **OK**.



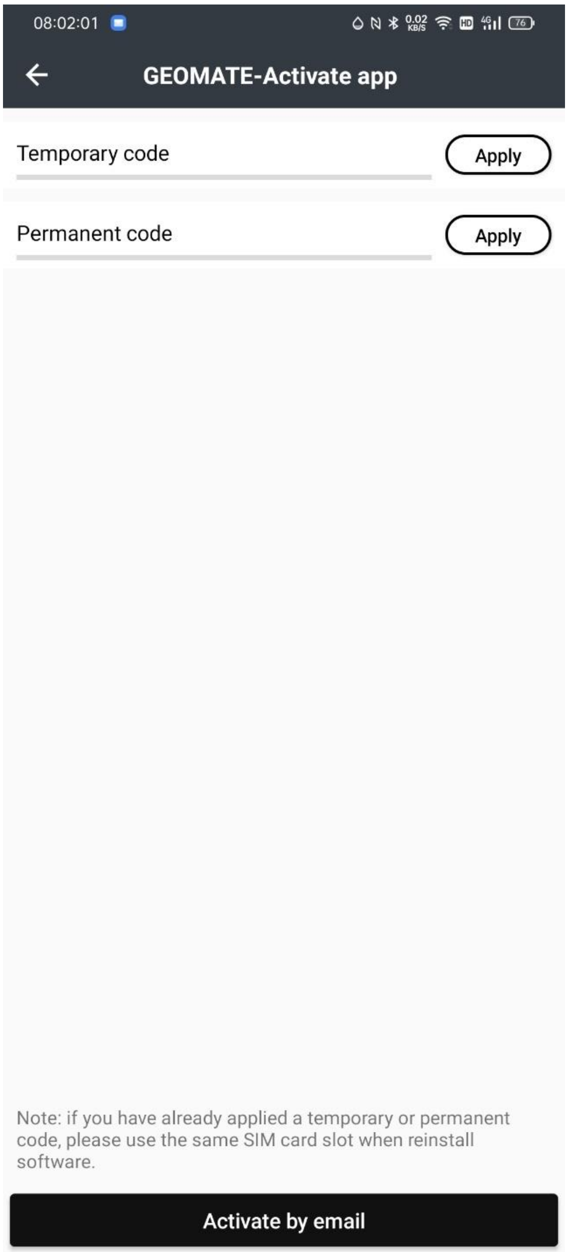


Then input user information and click **Register** to submit application. Please input your true e-mail address, because we will send “Account activation” mail to this e-mail address.





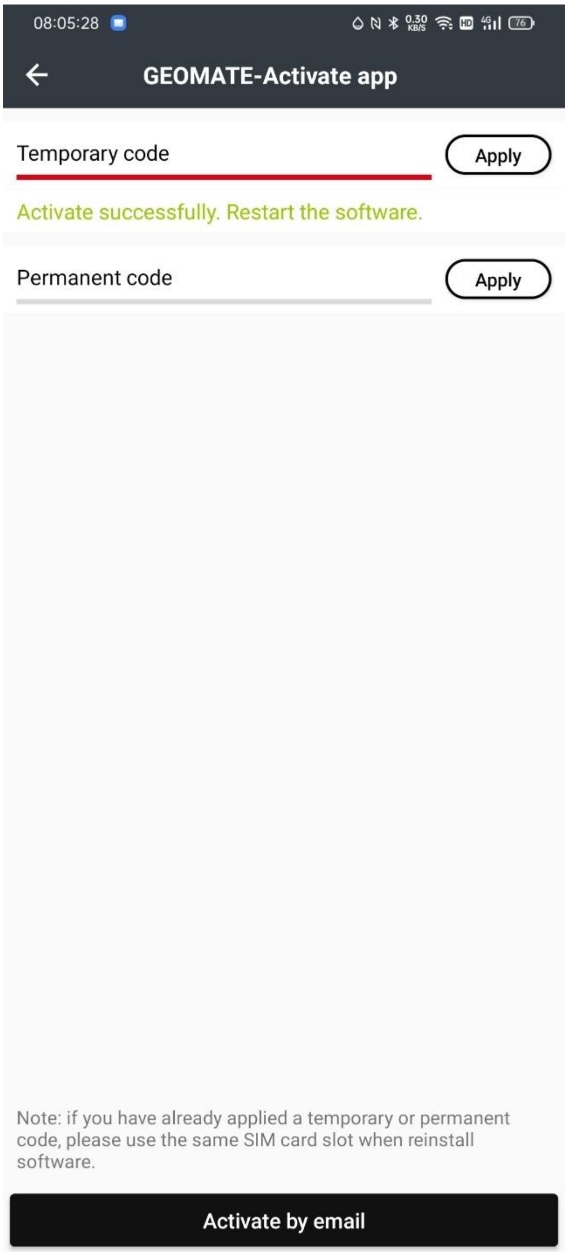
When users submit application successfully, it will prompt “Register successfully. Check your email to activate your account”. Click **OK** and go to mail box, and then users will see “Account activation” mail send by GeoMate. Please click the URL to activate your account. After activation of mail account, users can go to **Apply Register Code** interface in MateSurvey.



(2) **Apply Register Code**

(a) **Temporary usage**

Click **Apply** after **Temporary Code**, and users can apply register code immediately. Then users will see progress bar turns blue and the status reads “Successfully”, please remember to restart MateSurvey after registry.



(b) **Permanent usage**

Click **Apply** after **Permanent Code**. Input a pre-code, and click OK. Users should ask regional sales manager or dealer for pre-codes. Then users will see progress bar turns blue and the status reads “Successfully”, please remember to restart the application after registry.

(3) **Unbind Pre-code**

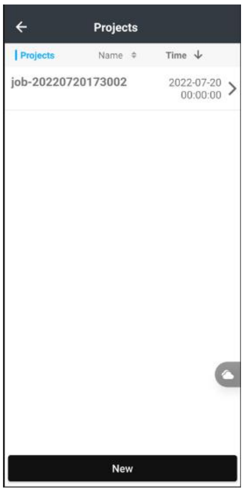
In general, one pre-code is corresponding to only one device. For some special situation, users can use unbind function to unbind the pre-code of current device, then this device will become unregistered status and the pre-code can be used in other device. Click **Unbind**, and users will see the progress bar turning blue. After the progress bar has turned blue “Unbind successfully” will appear. Then, users will find the current device becomes unregistered. It means you can use the pre-code in another device now.

2 Project

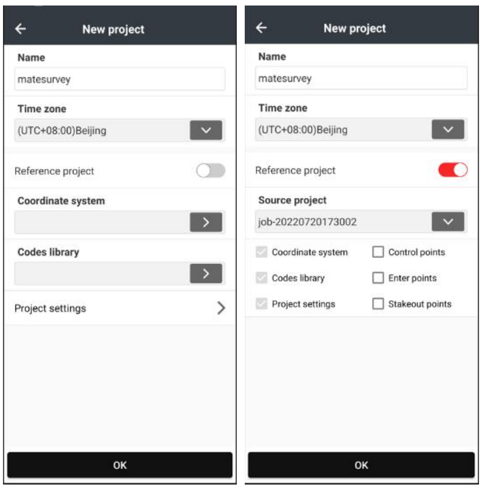
2.1 Projects

2.1.1 New

Click **New** to create a new project, users should set coordinate, codeList and other survey parameters.

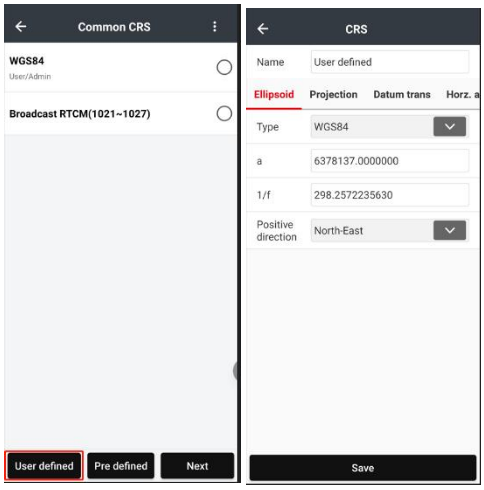


Name: Input the project name, backslash (/) is forbidden.
Time Zone: Choose the time zone in drop-down list from UTC-12:00 to UTC+14:00.
Source project: choose a reference project and get the parameters automatically, including Coordinate system, Codes library and Projects settings. Control point, Enter, and Stakeout points are optional.

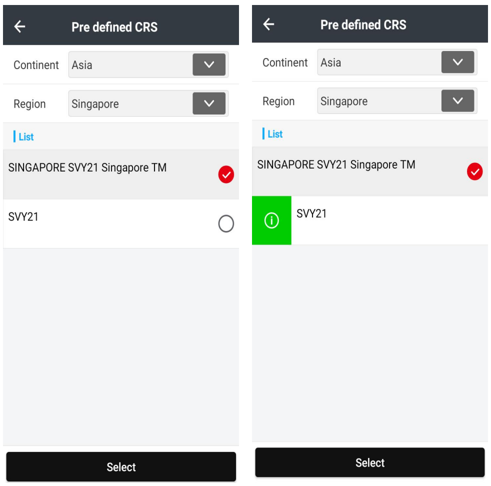


(1) **Coordinate System**:

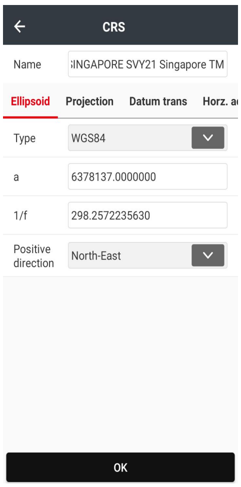
Users can create a new coordinate system or use the template of existing projects. Click **User defined** to create a new coordinate system.



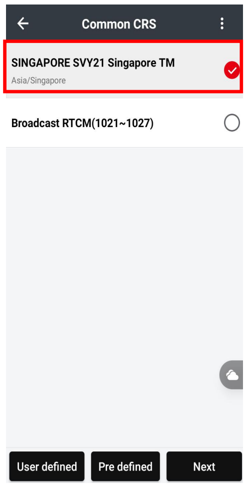
Set the right parameters according to the surveying area, and then click Save to finish CRS configuration.



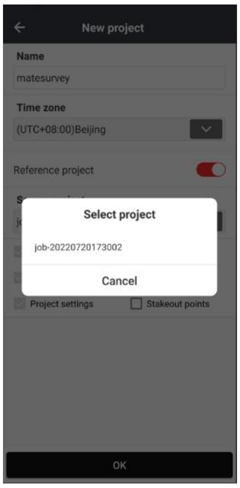
Click **Pre defined** to enter **Common Coordinate** interface, and then users are able to add a new coordinate system by clicking **Selecting**. Slide right and click the green button to check the coordinate system information.



Users can view the parameters of ellipsoid, projection, datum transformation, Horz. adjustment and Vert. adjustment. Click **OK,** it'll return to **Coordinate System** interface, and then click **Select** to finish CRS configuration.



Tick the **Source project** in Coordinate System to select project template, then it will show a list of historical projects. Users can select one and click **OK** to apply. It's used for applying the transformation parameters for different sites. For example, there is project A which has finished site calibration, while another project B needs the transformation parameters the same as project A. Then users can select project A in the project template while creating project B.

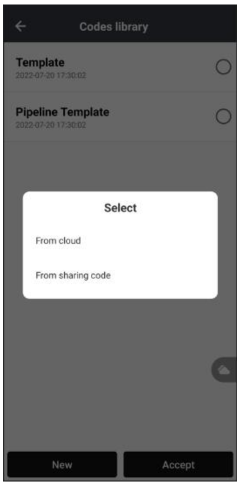


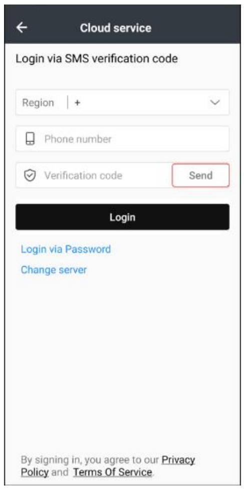
Note: Transformation parameters won't be applied if the new project is created without project template. Project template can apply all CRS parameters of the existing project.

(2) **Codes library**

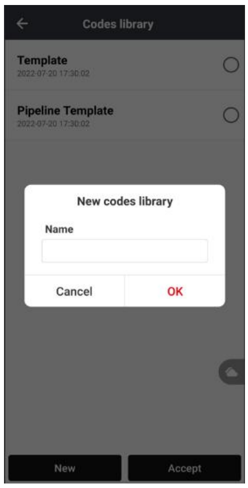
- **General Template**:

Firstly, users can import **from cloud** by inputting **IP address**, **Port**, **Users name**, **Password**. And users can choose whether **upload position**, **fixed time(s)** or **fixed distance** (the two can be modified).

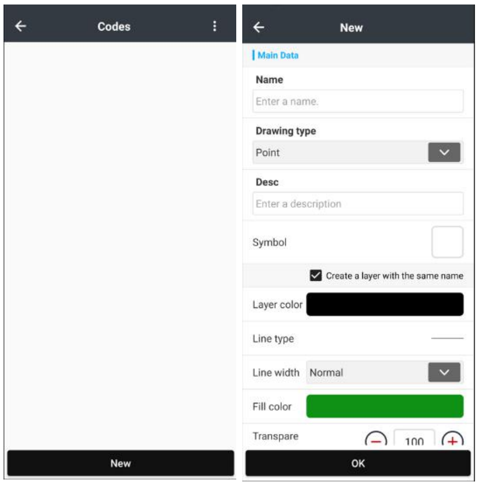




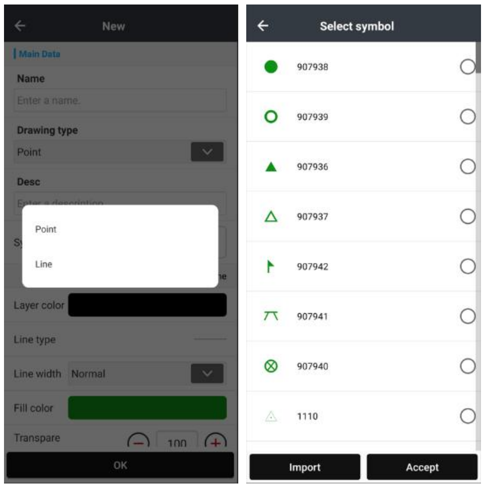
Secondly, click **New** to create a new codelist, input file name and click **OK**.



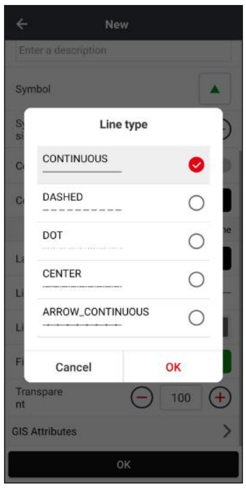
Click **New**, then input new code name, description, and choose drawing type from Point and Line. Choose Symbol from symbol list and decide the size of it.



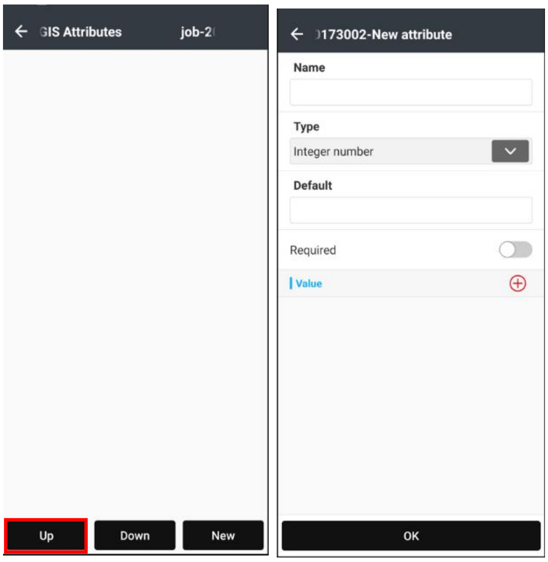
Users can choose color of the new code and decide if they want to color by layer.



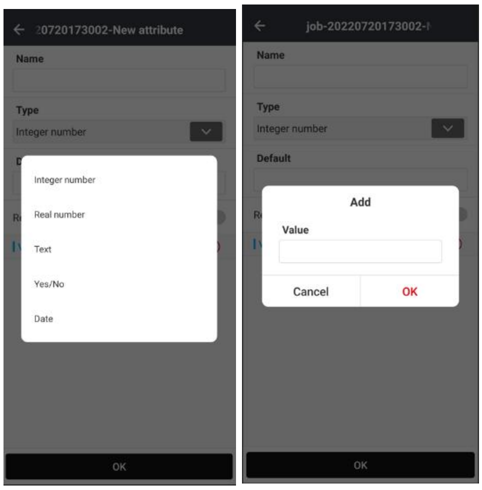
Users can select layer color and linetypes. Click **OK**, so the new layer would be created.



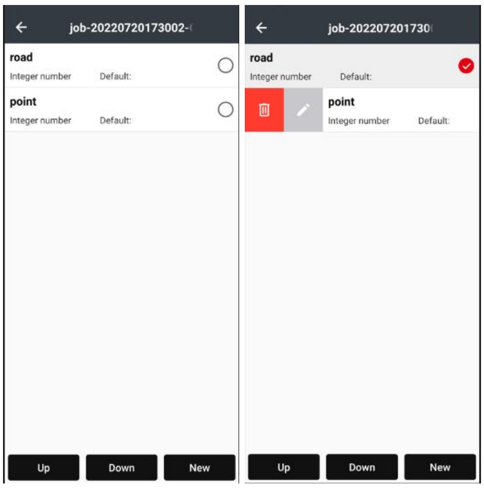
Users can create a new GIS attribute by clicking **New**. Input Name, default, and select type from pull-down menu.



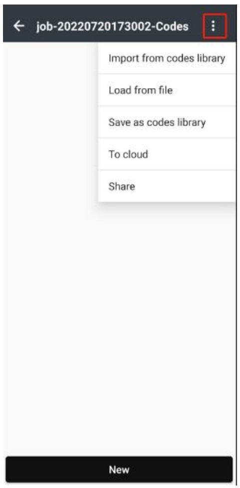
Users can decide if this attribute is obligatory. Click **Add** to add values to the attribute. Then click **OK** to create a code.



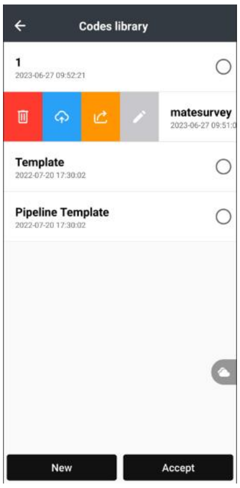
Up (down respectively) button is to move the selected attribute up (down respectively). Left slide the attribute to **edit** or **delete** it.



Back to New code interface and click **OK**. The new code would be saved. Click the icon on the upper right, and users can load, import, and save codes.



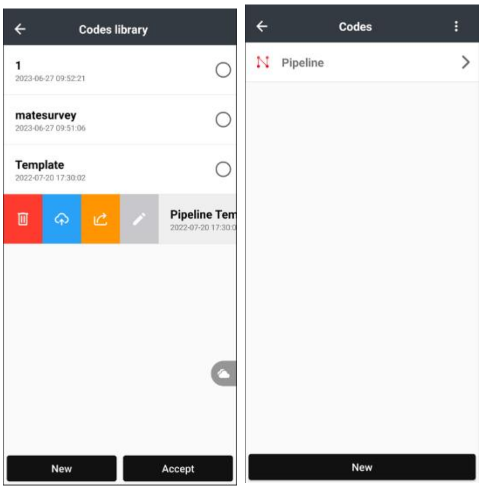
Click **load** to load from codes library. The library can be expanded **from cloud** and also users can create **new** library. Select a library and click **Accept**.
Left slide the code to **edit** or **delete** it. In Codes library, left slide to **delete**, **upload**, **share**, and **edit** the codes. Choose a code and click **Accept**.



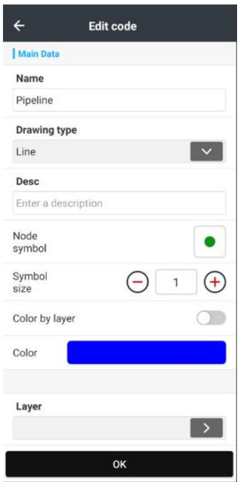
- **Pipeline Template**:

For high precision underground pipeline measurement, please remember to choose **PIPELINE TEMPLATE**, otherwise, users can't see **Pipeline** icon in **Survey** menu.

Click **Edit**, users will see only one line code named “Pipeline”. Please don’t create other code, because user-created code in **PIPELINE TEMPLATE** is void.

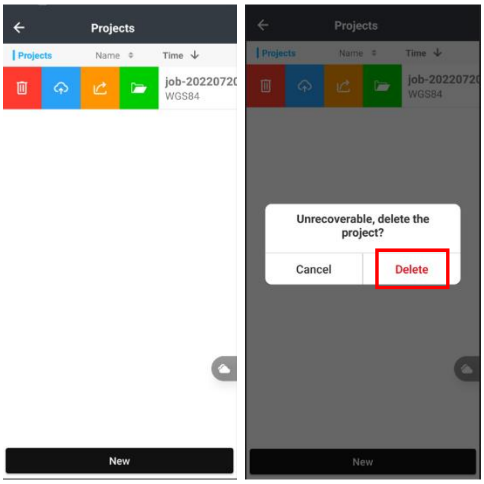


Choose **Pipeline** and click **Edit**, and then users can do as in general template.



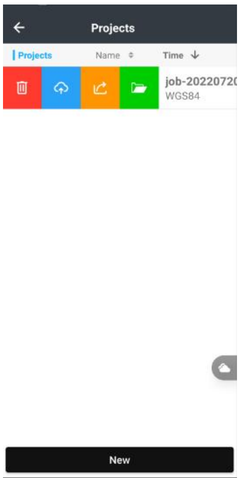
2.1.2 Delete

When users enter project, left slide to delete, upload, share and open. Click delete icon, it will prompt "Unrecoverable, delete the project?". Select **Delete** to delete the project, or select **Cancel** to cancel deleting.



2.1.3 Open

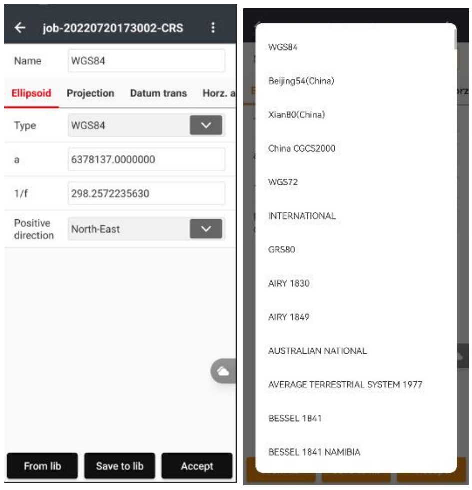
To continue an existing project, users can click open icon to open previous project.



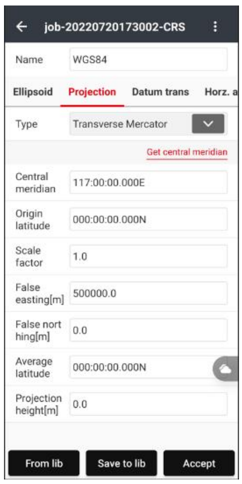
2.2 CRS

Coordinate Reference System (CRS) offers users some parameters including ellipsoid, projection, datum transformation, plane adjustment and height fitting.
User should open the project first, then click CRS to set the coordinate system.
Name: Input CRS name, it's not required to define CRS name like LS7.

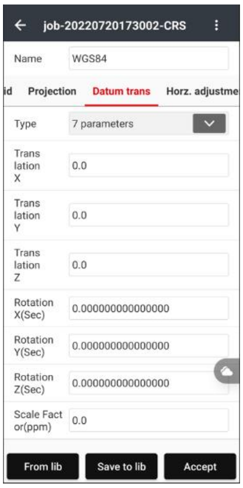
(1) **Ellipsoid**: Includes ellipsoid name, a, 1/f, etc. Users can choose ellipsoid name from pull-down menu (different ellipsoid name is corresponding to different parameters) as well as manually input.



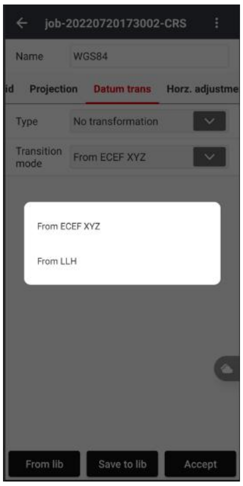
(2) **Projection**: There are some built-in common projection methods of different countries and regions, including Gauss projection, Transverse Mercator projection, UTM projection and so on. And the parameters of the projection model are displayed in the interface. Only the central meridian is needed to change usually, which refers to the central meridian of the plane projection. The average latitude of the survey area needs to be input here for a custom coordinate system, requesting the latitude error less than 30 minutes.



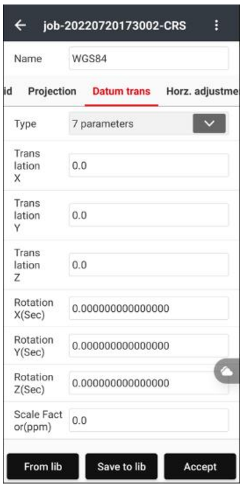
(3) **Datum Trans**: Represents the mathematical model for transformation between two coordinate systems. Datum transformation model includes none parameter, three parameters, seven parameters, seven parameters Bursa, and grid models. Users can input the local 7 parameters directly, no needing the site calibration any more.



(a) **None Parameters**: Users can choose coordinate transformation mode, from XYZ or from BLH.

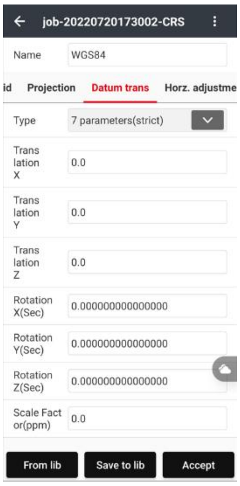


(b) **7 Parameters**: Requires at least three known points, and the points can be under the national coordinate system or the coordinate system that existing small rotation from the WGS84 coordinate system. Preferably three or more known points so that LandStar™ 8 can check the correctness. The mathematical model of this method is strict, and it is critical to the precision of the known points. This method is usually used in a wide-range work.

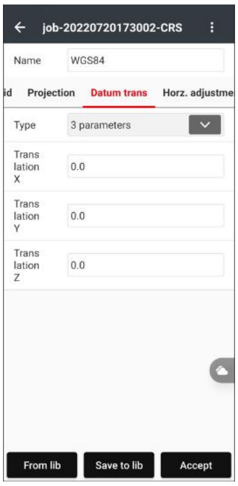


Note: When accuracy of known points is not high, 7 parameters transformation is not recommended.

(c) **7 Parameters Strict**: Add Strict modem for 7 parameters.

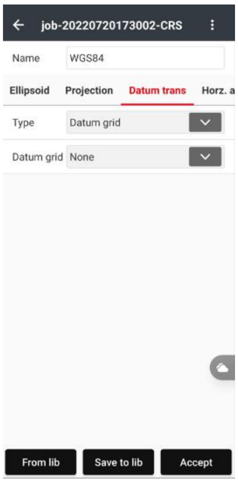


(d) **3 Parameters**: Requires at least one known point, and the points can be under the national coordinate system or the coordinate system that existing small rotation from the WGS84 coordinate system. Preferably two or more points are known so that checking the correctness of the known points. This method is suitable small-range work, of which accuracy is determined by the operating range. The larger the operating range users have, the lower the accuracy users get.

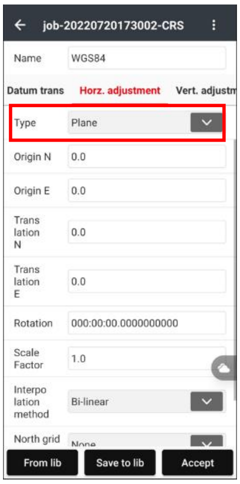


(e) **Grid**: Choose to use grid file for datum transformation (recommend to use CGD file). to find **Geoid** folder in internal storage of controller, and put grid file in it before using this function. The software currently supports the grid file of CGD/GRD/BYN formats.

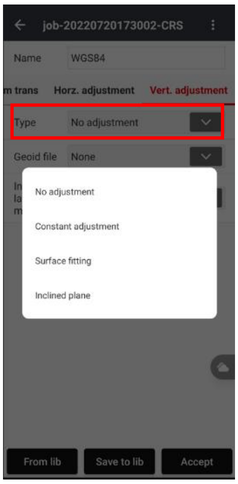
![GEOMATE]



(4) **Horz. adjustment**: The calibration parameters will be displayed on the interface of the coordinate system parameters after site calibration and application, and users can check them when you open the project successfully. It supports **Plane** and **No adjustment** at present. The software currently supports the grid file of CGD/GRD/BYN formats..



(5) **Vert. adjustment**: Supports four kinds of algorithms: **No adjustment**, **Constant adjustment**, **Surface Fitting** and **Inclined plane**, of which **No adjustment** is the default one.



(a) **Constant adjustment**: Need at least one starting point.

(b) **Surface Fitting**: Generates a best-fit parabola for the abnormal height of many benchmarks. It has high requirements for the starting data and it may cause divergence of the elevation corrections if the fitting level is too poor. This method needs at least five starting points.

(c) **Best Practice**: Best Practice is the height transformation model of Trimble TGO software.

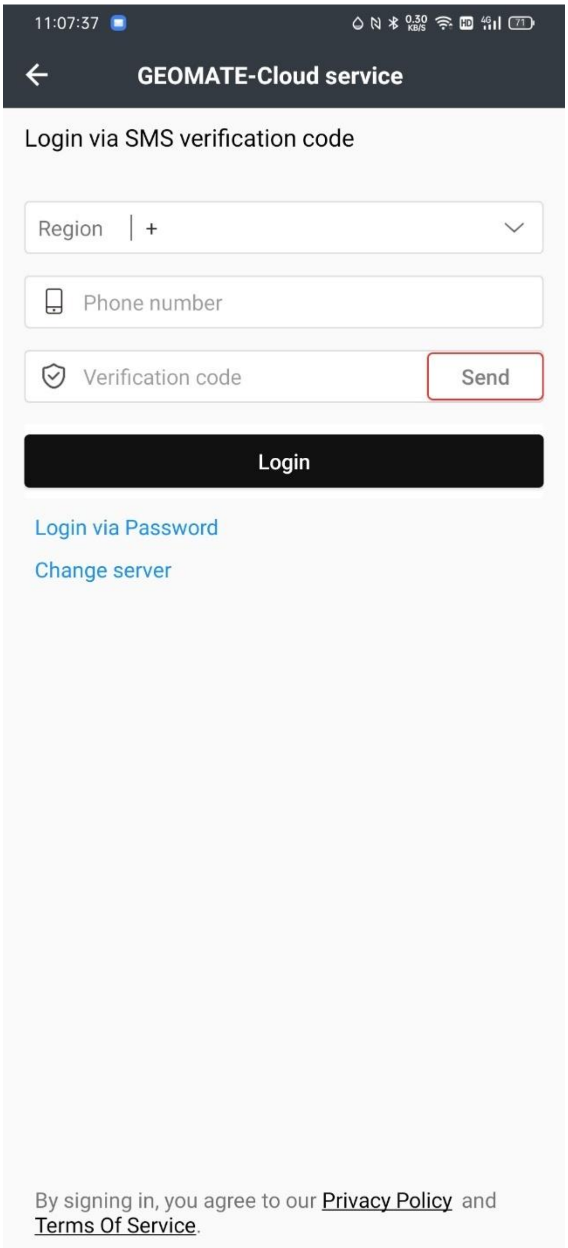
(d) **Geoid Model**: Click to choose the geoid model file when select this method. The software currently supports the geoid model file of CGD/GGF/BIN/GSF/GRD/GRI/BYN/ASC formats.

2.3 Codes

The main function of **CodeList** is to manage codes under the different work conditions. If users save codes in one list, it is not easy to distinguish. So, it is better to create different codelist for saving different codes, and users can select the corresponding codelist based on the particular work condition. Please refer to 2.1.1(2)**Codes library**.

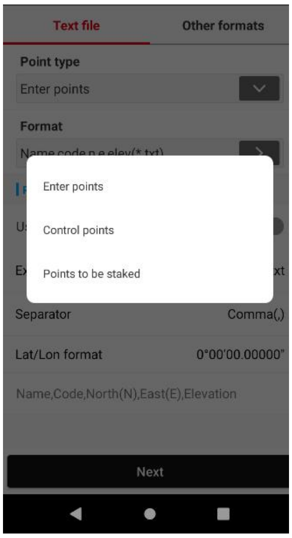
2.4 Cloud

Cloud is the login interface of Cloud service. Users can upload or download projects, coordinate systems, work modes, etc. Users should ask local dealer or sales manager for obtaining an account and password to use Cloud. GeoMate will help customers to build own cloud server (customers need to provide server and network) if necessary. For more information, please contact local dealer or sales manager.

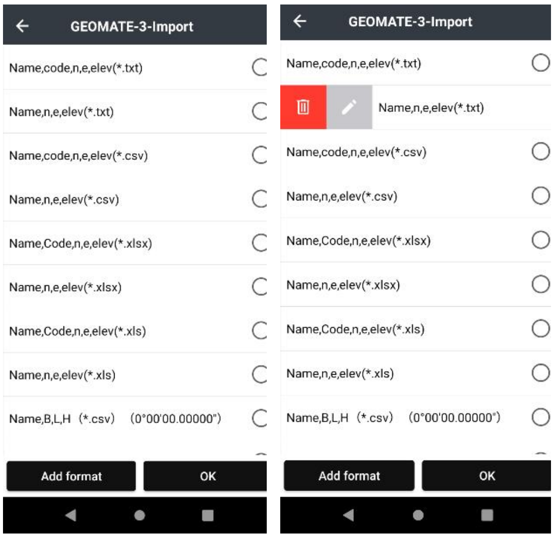


2.5 Import

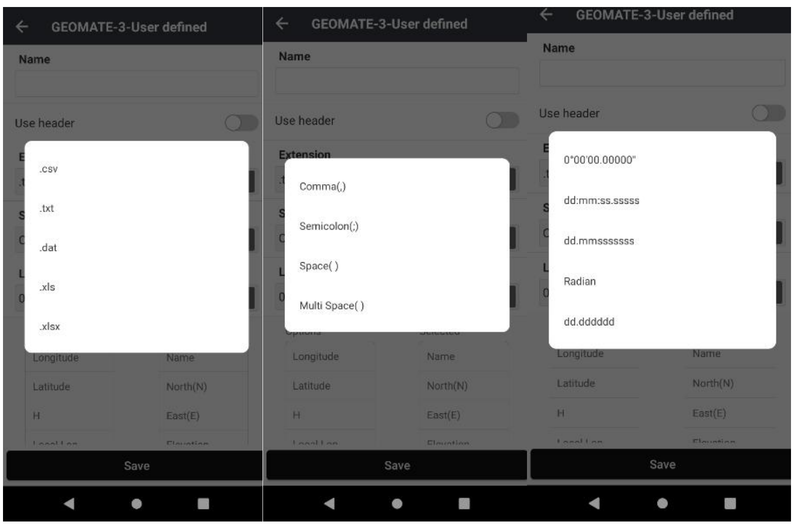
The function can be used for importing the point coordinates file in specific formats.
Click **Import** in main interface, and the software will import the existing data according to the requirement format in device or SD card.
Point type: user can select the point type, enter point, control point, and points to be staked.



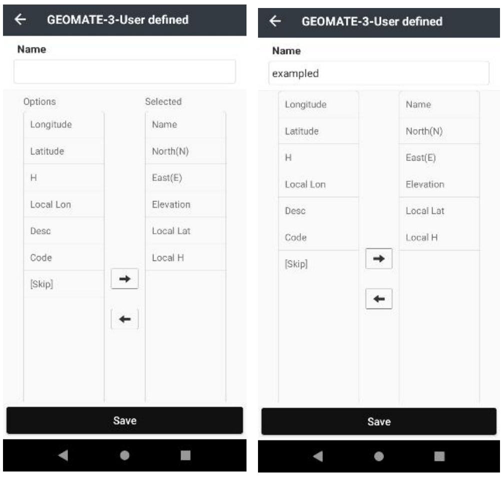
Format: user can select the target type from DAT, TXT, CSV, XLSX, and XLS. If the data contains table header, use header should be set by right slide menu.



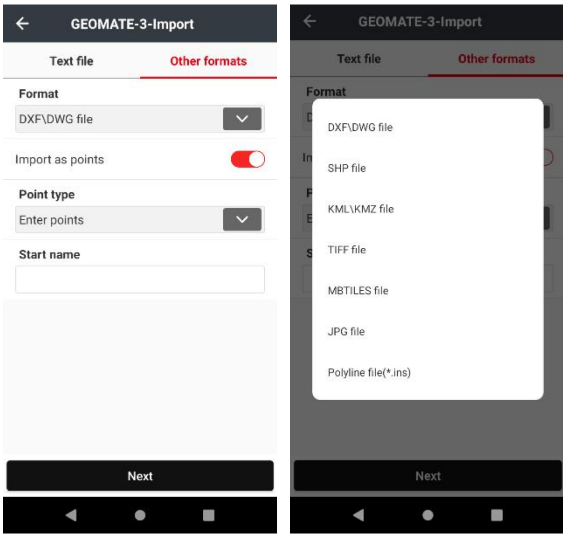
Click the edit button, enter the user defined interface. use header should be set by right slide menu. Choose the extension, separator, and lat/lon format.



As for header, click the option to add the selected contents, and click selected contents to cancel the options. Click the arrow, add or cancel all the options at one time. After finishing settings, turn on the use header.



Other formats: Support DXF\DWG, SHP, KML\KMZ, TIFF, MBTILES, JPG, and POLYLINE file format. Users can change the format into points by selecting the function.



Select point type from Enter point, Control point and Points to be staked. Set the name, then click next to choose the imported file.

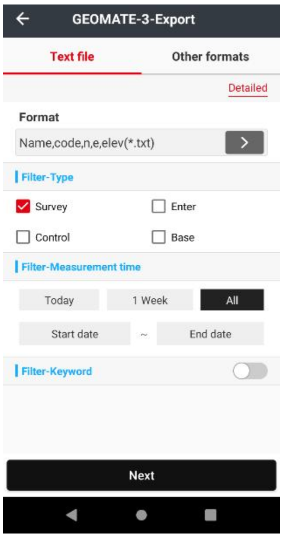
Note: MateSurvey will automatically apply the same setting when users create a new project.

2.6 Export

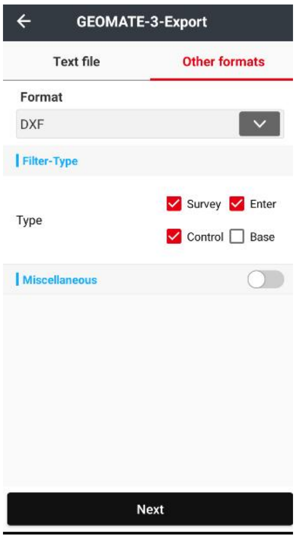
The function can be used for exporting the point coordinates file in specific formats.

Filter-Type: Users can choose exporting point types including **Survey Point**, **Enter Point, Control Point** and **Base Point**.

Filter-Measurement Time: Users can set the start time and the end time for exporting data.



Format: Support DAT, TXT, CSV, XLSX, XLS. There are several available formats in common sequence that provides users to use and users can also set the format in **Customize** (users can customize the import contents while choosing the CSV, DAT and TXT format.)
Other format: Support DXF, SHP, KML, KMZ, HTML, and RAW date, it will be detailed in 2.5.
Path: Select the path of export file. Click the folder and it will display a blue select prompt. Then, click **Export** to finish.



Note: MateSurvey will automatically apply the same setting when users create a new project.

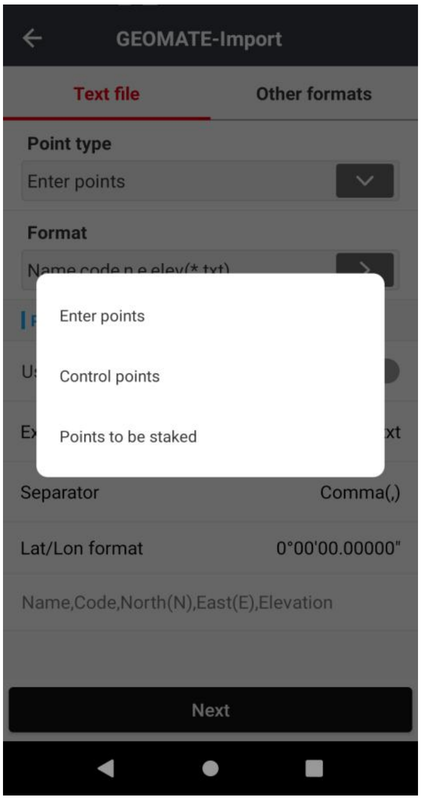
2.7 Points

This function can view coordinates library, which includes input point, control point, survey point, and points to be staked.

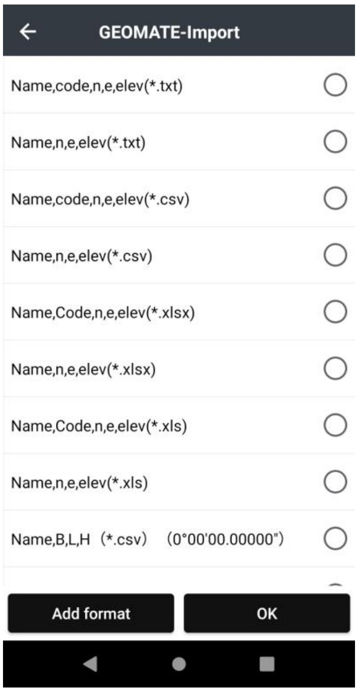
2.7.1 Import

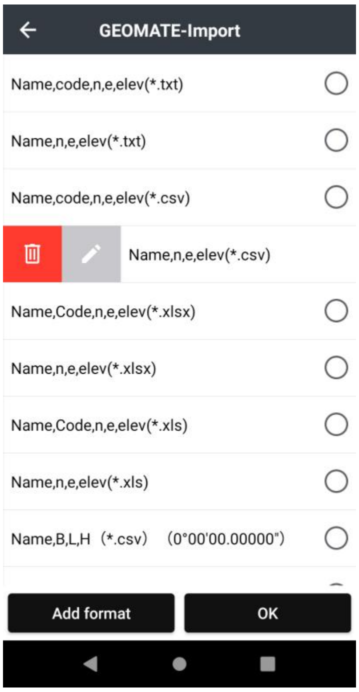
The function can be used for importing the point coordinates file in specific formats.
Click **Import** in main interface, and the software will import the existing data according to the requirement format in device or SD card.
Point type: user can select the point type, enter point, control point, and points to be staked.

GEOMATE

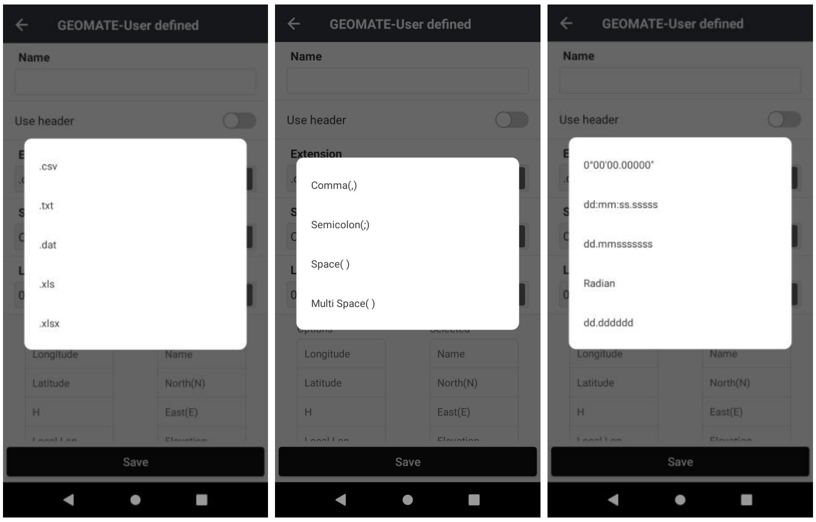


Format: user can select the target type from DAT, TXT, CSV, XLSX, and XLS. If the data contains table header, use header should be set by right slide menu.

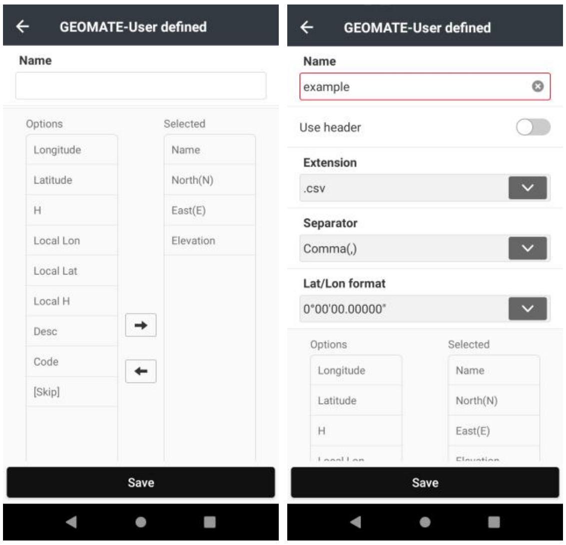




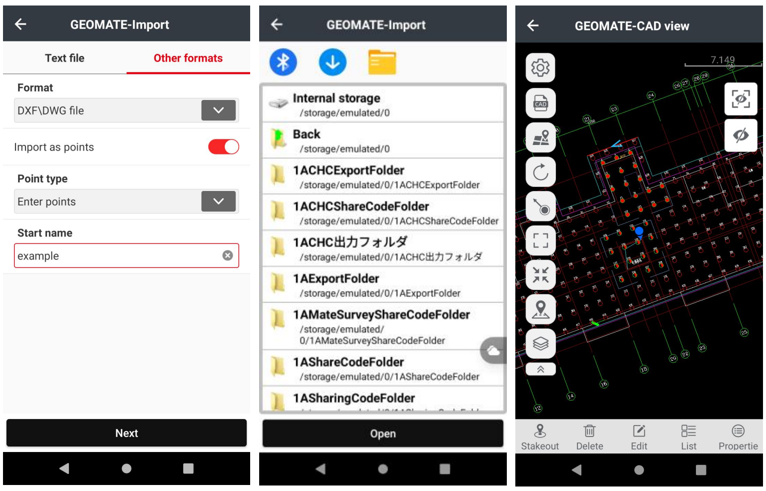
Click the edit button, enter the user defined interface. use header should be set by right slide menu. Choose the extension, separator, and lat/lon format.



As for header, click the option to add the selected contents, and click selected contents to cancel the options. Click the arrow, add or cancel all the options at one time. After finishing settings, turn on the use header.



Other formats: Support DXF\DWG, SHP, KML\KMZ, TIFF, MBTILES, JPG, and POLYLINE file format. Users can change the format into points by selecting the function.

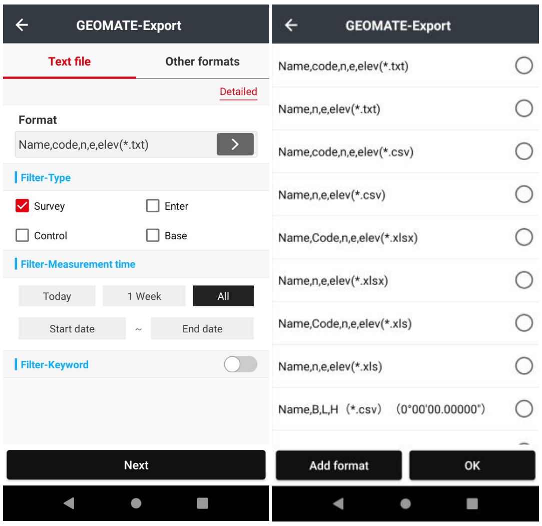


Select point type from Enter point, Control point and Points to be staked. Set the name, then click

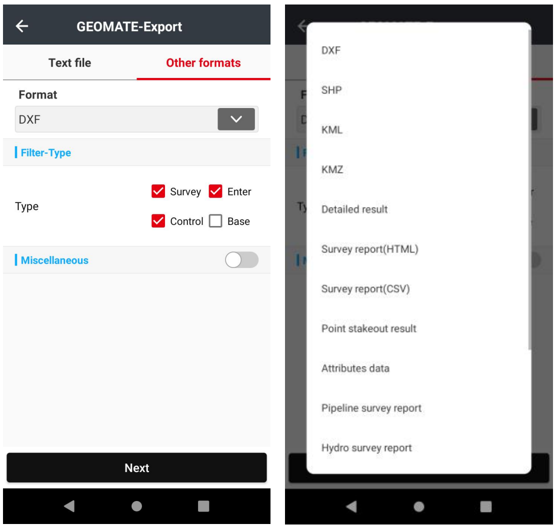
next to choose the imported file.
Note: MateSurvey will automatically apply the same setting when users create a new project.

2.7.2 Export

The function can be used for exporting the point coordinates file in specific formats.
Filter-Type: Users can choose exporting point types including **Survey Point**, **Enter Point, Control Point** and **Base Point**.
Filter-Measurement Time: Users can set the start time and the end time for exporting data.



Format: Support DAT, TXT, CSV, XLSX, XLS. There are several available formats in common sequence that provides users to use and users can also set the format in **Customize** (users can customize the import contents while choosing the CSV, DAT and TXT format.)
Other format: Support DXF, SHP, KML, KMZ, HTML, and RAW date.

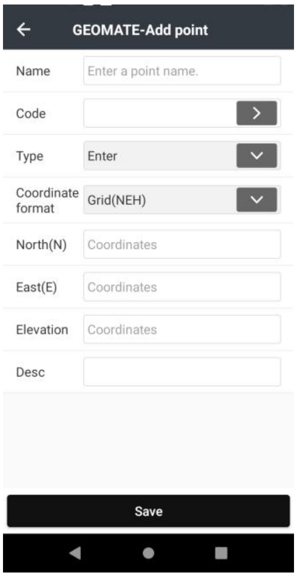


Path: Select the path of export file. Click the folder and it will display a blue select prompt. Then, click **Export** to finish.

Note: MateSurvey will automatically apply the same setting when users create a new project.

2.7.3 Add

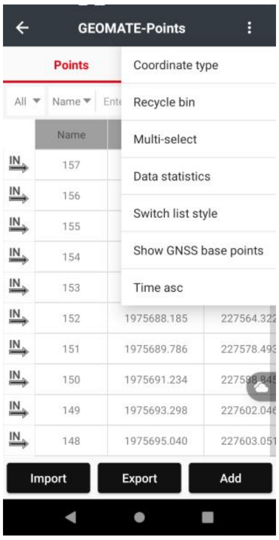
This function can create a new point. Click **Add** to create a point. Creating a point needs some attributes as follows: name, code (input as need), type(including: enter and control point), coordinate formats (including: local NEH, local BLH, local XYZ, WGS84 BLH, WGS84 XYZ), point class (including normal point and control point). Then, input the point coordinates that users create, Desc is optional.

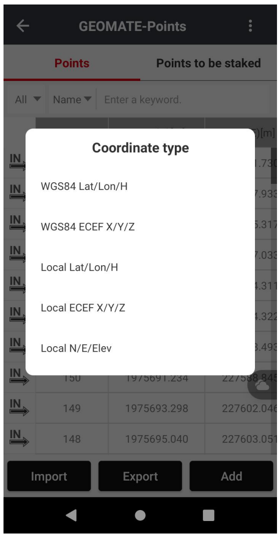


Note: When the point has reel number, it will prompt "Projection Error" after adding point, and users should add reel number in "False East" in **Projection** table of **CRS** interface.

2.7.4 Coordinate type

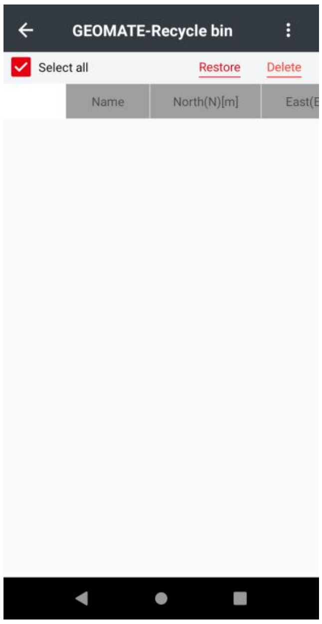
This function can select different coordinate type. Click **Coordinate Type** to select point type.





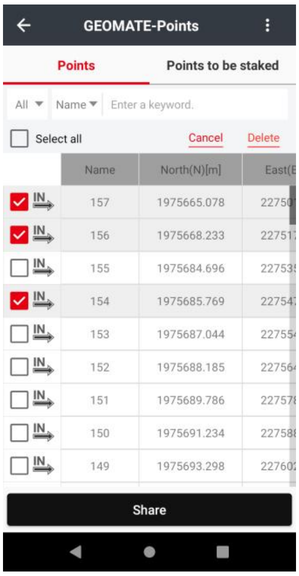
2.7.5 Recycle Bin

This function can restore deleted points. Click **Restore** to recover selected deleted points. Click **Delete** to clear the bin.



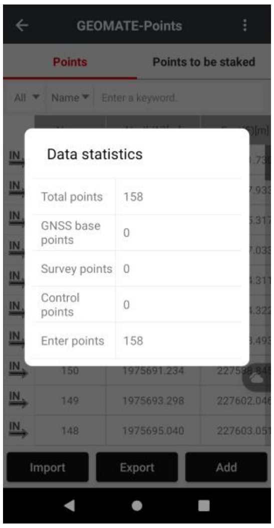
2.7.6 Multiple-select

This function can select multiple points. Click **Multiple Operation** to manage not only one item but also multi-items and do operation on multiple points.



2.7.7 Data statistics

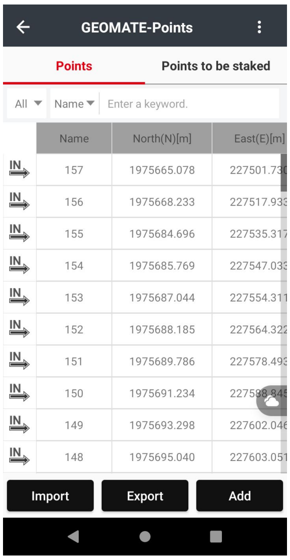
This function can view the different type of points. There are five types, including total points, GNSS base points, survey points, control points and enter points.

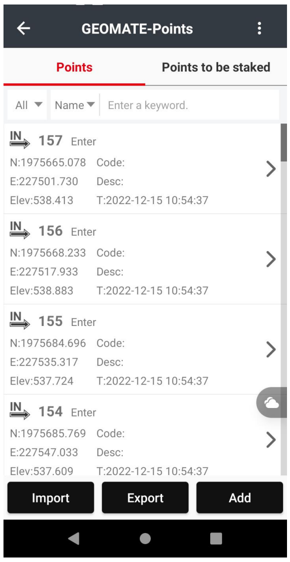


2.7.8 Switch list style

This function can **Switch** list style. Click **Switch list style** to change the style.

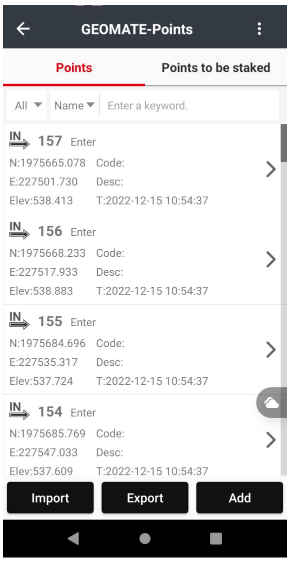
GEOMATE





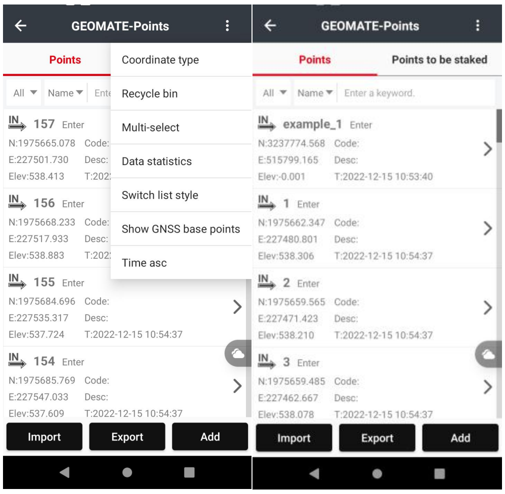
2.7.9 Hide GNSS base points

This function can **Hide** GNSS points. Click **Hide GNSS base points** to hide them, click **Show GNSS base points** to show them.



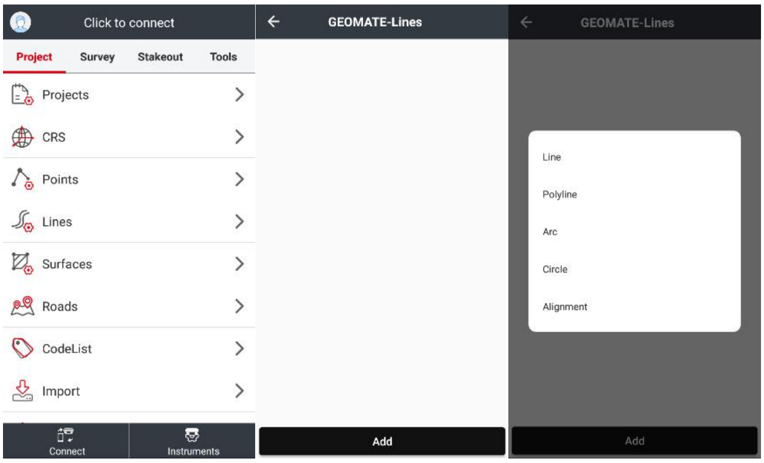
2.7.10 Time asc.

This function can sort points in time ascending order. Click Time asc to sort points in time ascending order, also can click Time desc to sort points in time descending order.



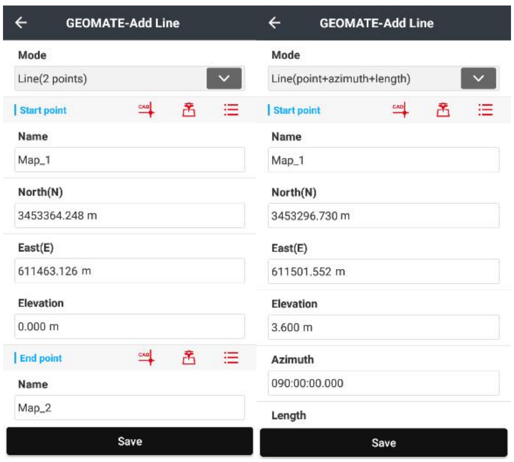
2.8 Lines

Click **Add** to add different types of lines, including Line, Polyline, Arc, Circle and Alignment.

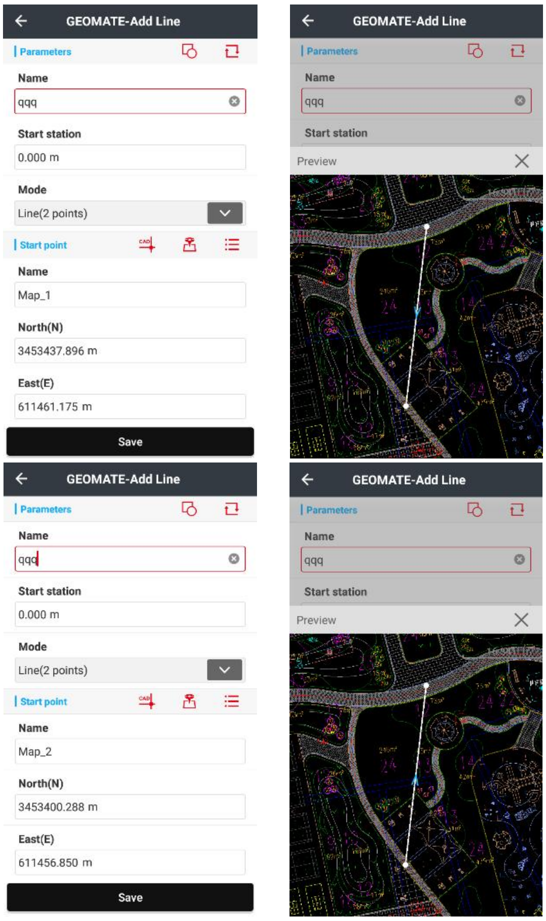


Line:

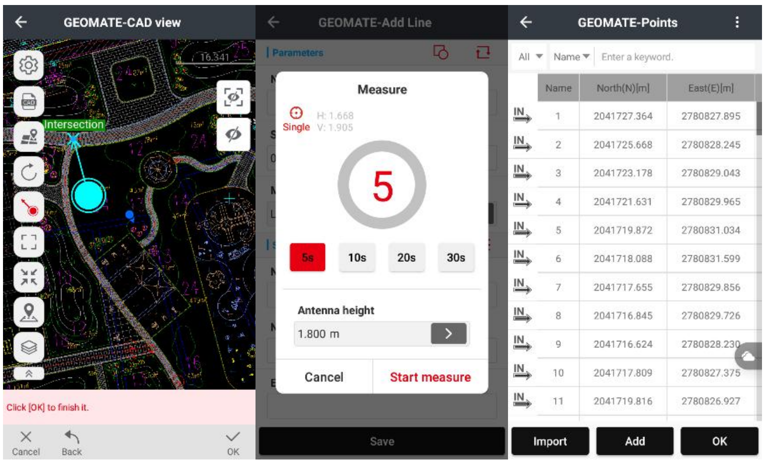
Click **Add** to select **Line**, enter the following new interface to create a line. There are two Methods including **Two Points** and **One Point + Azimuth + Length.** Two points, user should input **Name, North, East, and Elevation**. The other way, user should input **Name**, **North, East, Elevation, Azimuth, Length and Slope.**



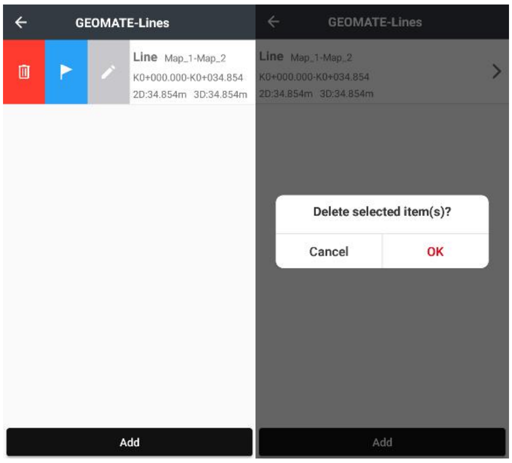
After setting the above values, click **Save**, a line can be created. Users can check the graph by clicking the rectangle button and inverse the direction by clicking the arrow button.



And there are 3 methods to select one point, including from CAD, from point survey and from point lists.

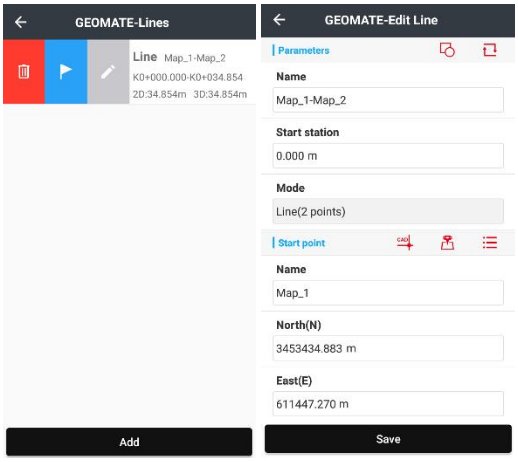


(1) **Delete:** Select a line, right slide to click **Delete**, and then it will pop up a dialog box "Delete Selected item?" Select **OK**, remove this record; select **Cancel**, do not delete this record.



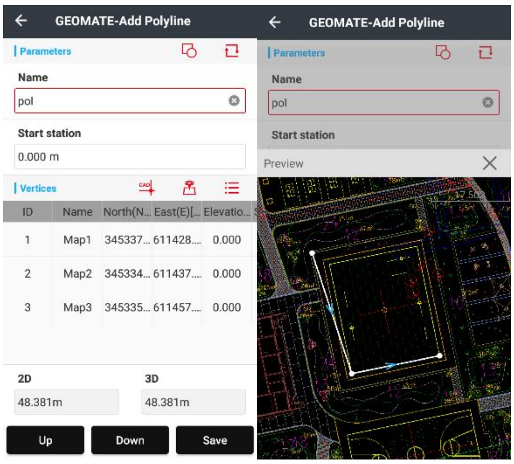
Also, users can click the flag button to stakeout the selected line.

(2) **Detail:** Select **Line**, click **Edit** to view detailed information about the selected line.



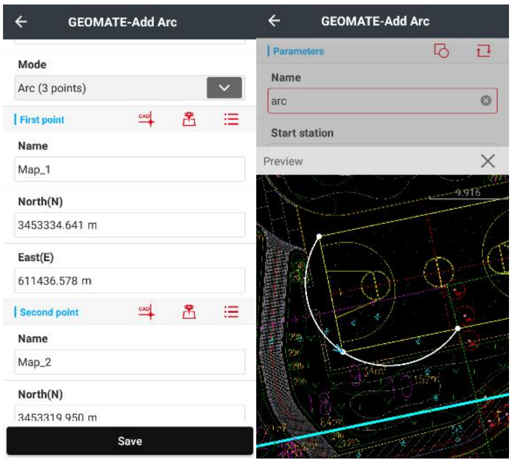
Polyline:

Users input the name of the polyline, start station distance, and select points. Click **Up** and **Down** to adjust the order of the points.



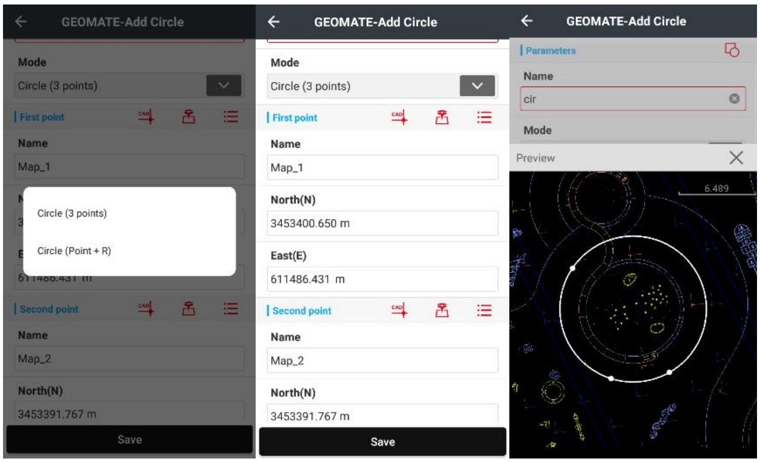
Arc:

Users input the arc name, start station distance. Select the arc mode and input values as the mode needs.



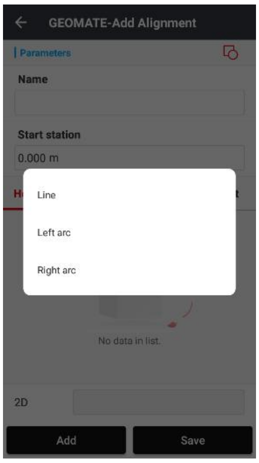
Circle:

Users input the circle name. Select the circle mode and input values as the mode needs.

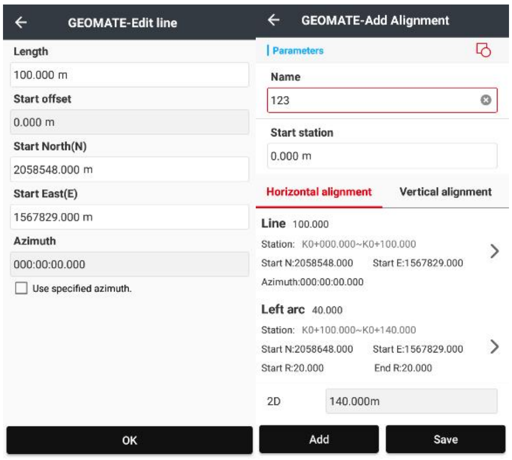


Alignment:

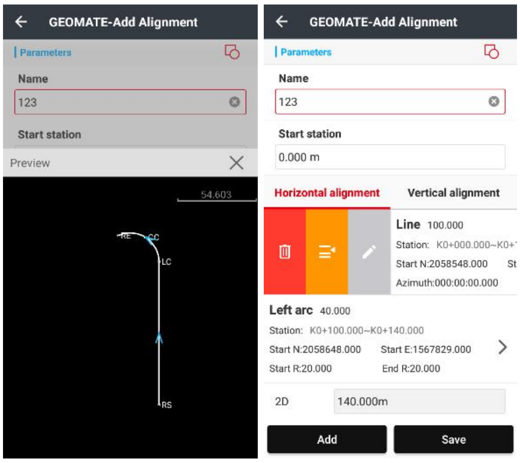
Users can click Add to create Line, Left arc and Right arc.



Input Length, Start offset, Start North, Start East and Azimuth if using specified azimuth. Click **OK** to finish adding.



Click rectangle icon on the upper right to see the graph.



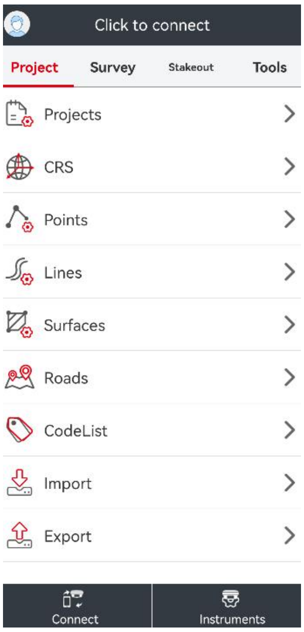
2.9 Roads

Please check Roads at Chapter 6. Road

3 Config

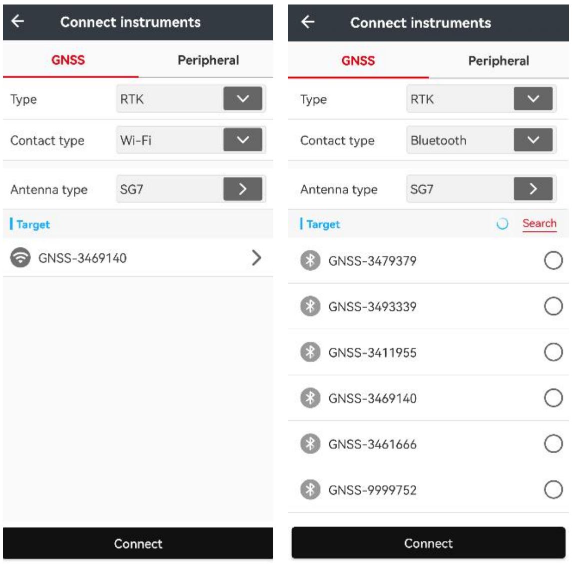
3.1 Connect instruments

For device connection.

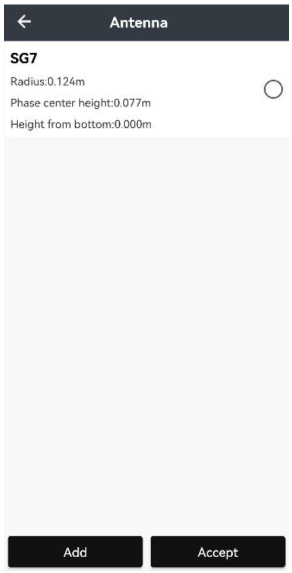


(1) **GNSS**

GNSS table is for receiver connection.
Type:includes: **RTK, Android location, Simulation**.
Simulation: Enter simulation mode, and then users can use or test all the functions of this software. Meanwhile, the function can simulate position by inputting coordinate.
Contact type: Including the choices of **Bluetooth** and **WiFi.**



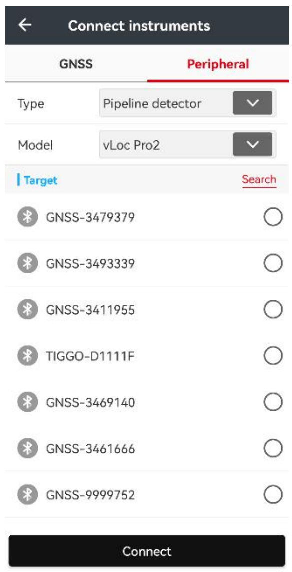
Antenna Type: Click **Antenna Type List**, select antenna type (Users can select antenna type of different products in different manufacturers). Users can handle specific item by clicking **Add**.



Target: While using Bluetooth connection, click **Search** to the interface of Bluetooth. Select Bluetooth management, click **Refresh** to find the device to Pair (Default password is 1234 if it's required to input). When the pair is successful, just turn back to the connection interface. Then click **Connect**. When the connection is successful, users will back to config interface. While users use **WiFi** connection. Click **Search**, then it will show users **WLAN** interface. Click **Refresh** to find the SN of current receiver, input password (Default password is 12345678), then click to connect the target. When the connection is successful, just turn back to the connection interface. Then click **Connect**. When the connection is successful, users will back to config interface.

Connect: Click to start connection.

Disconnect: Break the current connection.



(2) **Peripheral**

Peripheral table is for peripheral device connection.

Type: Including the choices of **Pipeline Detector, Laser Rangefinder.**

Model: Including the choices of **vLoc Pro2** and **Simulation**.

Simulation: Enter simulation mode, and then users can use or test all the functions of this software.

Meanwhile, the function can simulate position by inputting coordinate.

Target: While using Bluetooth connection (Suitable for i80 and GNSS receiver), click **Search** to the interface of Bluetooth. Select Bluetooth management, click **Refresh** to find the device to Pair (Default password is 1234 if it's required to input). When the pair is successful, just turn back to the connection interface. Then click **Connect**. When the connection is successful, users will back to config interface.

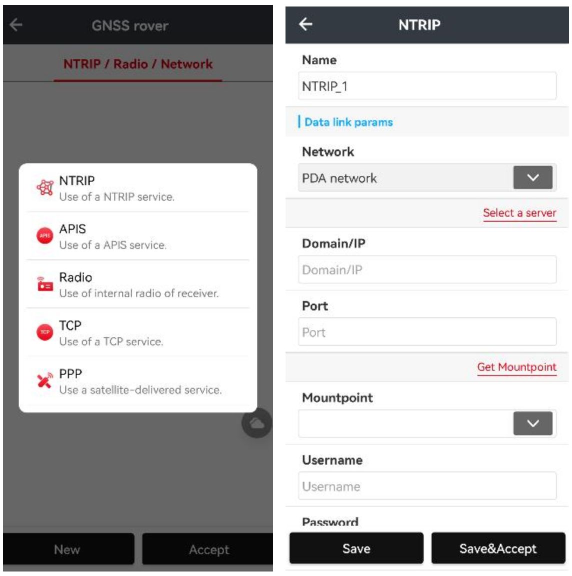
Connect: Click to start connection.
Disconnect: Break the current device connection.

3.2 GNSS rover

Main screen of GNSS rover displays the configuration of the current equipment, including the receiver setting and device operating modes. In most cases, we use the common and specific operation mode to meet the daily trial.

3.2.1 NTRIP

Click **New** to create a work mode and choose **NTRIP** table.



Name: Enter a name for this work mode.
Network: Choose a model for supplying internet. Include **PDA network** and **Receiver network**.
Domain/IP: input the corresponding **Ntrip IP.**
Port: input the corresponding **Port.**
Select a server: you could add a server and save it. Next time you can choose it in this interface.

Get Mountpoint: get the **Mount point**.
Mount point: choose a **Mount point** you need
Username: The name of user's Ntrip account.
Password: The password of user's Ntrip account.
Save: just save this work mode.
Save&Accept: save and apply this work mode.
If you click Save&Accept, it will pop up "Accept successfully, check detials?" Click **OK** to enter **Instrument Info** interface.

Users can see whether Ntrip login successfully and the reason of why login failed.
For example:

(1) When it prompts "Requesting…", Matesurvey is receiving login messages from the receiver.

(2) When it prompts "No SIM Card!", users need to input SIM card in receiver first.

(3) When it prompts "3G Module is Dialing, Please Wait…", users need to wait till 3G module dials up successfully. If users wait for a long time and still can't login successfully, users need to check status of 3G module and activate 3G module dialing up function.

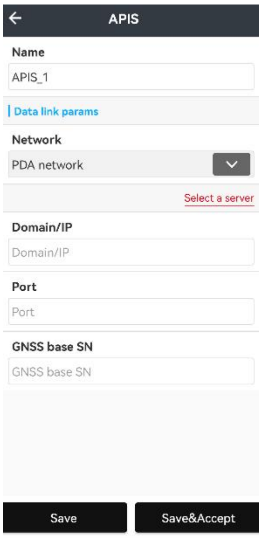
(4) When it prompts "User name and password error!", users need to check current user name and

password and input correct one.

Then the green LED will be flashing and the status will come from **Single** to **Fix**, which means the rover is getting the correction data.

3.2.2 APIS

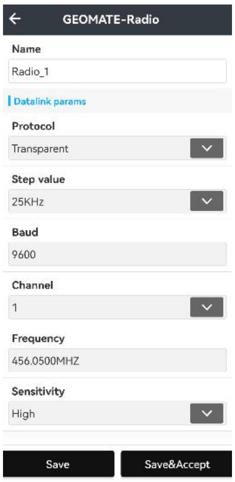
Click **New** to create a work mode and choose **APIS** table.
Name: Enter a name for this work mode.
Network: Choose a model for supplying internet. Include **PDA network** and **Receiver network**.
Domain/IP: input the corresponding **APIS IP.**
Port: input the corresponding **Port.**
Select a server: choose a server. Or you could add a server and save it. Next time you can choose it in this interface.
GNSS base SN: Enter the serial number of base receiver.
Save: just save this work mode.
Save&Accept: save and apply this work mode.



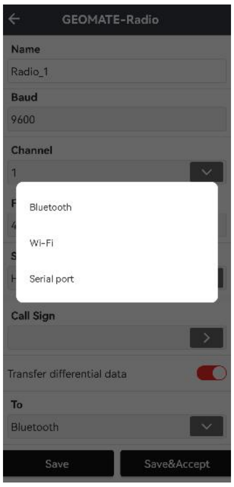
Then the green LED will be flashing and the status will come from **Single** to **Fix**, which means the rover is getting the correction data.

3.2.3 Radio

Click **New** to create a work mode and choose **Radio** table.
Name: Enter a name for this work mode.
Protocol: Select a protocol. Include Transparent, TT450,SATEL_3AS.
Step Value: 25kHz or 12.5kHz optional, it will only display supported step value of receiver.
Baud: 9600 or 19200.
Channel: different channel will show different frequency. And also can be customized.
Frequency: normally can't be changed and if you choose **User defined**, you can change it.



Sensitivity: set as default
Call Sign: if you open it, the signal will transmit the message.
FEC: enable or not, if you need it.
Transfer differential data: Forward data through **Bluetooth**, **Serial Port**, and **WiFi**.
When users choose Bluetooth/WiFi, correction data in current device will be forwarded to Bluetooth/WiFi, so that other devices can receive the correction data by connecting the Bluetooth/WiFi of current device.
When users choose serial port, correction data in current device will be forwarded to serial port, users can not only connect current device to computer by serial port and view correction data, but also connect current device to external radio.

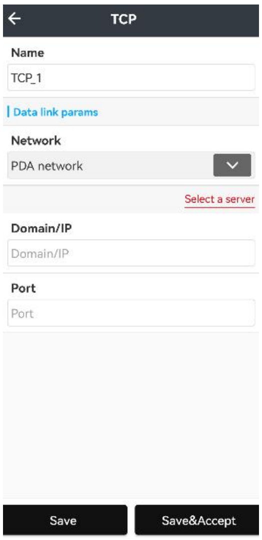


Save: just save this work mode.
Save&Accept: save and apply this work mode.
Then the green LED will be flashing and the status will come from **Single** to **Fix**, which means the rover is getting the correction data.

3.2.4 TCP

Click **New** to create a work mode and choose **TCP** table.
Name: Enter a name for this work mode.
Network: Choose a model for supplying internet. Include **PDA network** and **Receiver network**.
Domain/IP: input the corresponding **IP.**

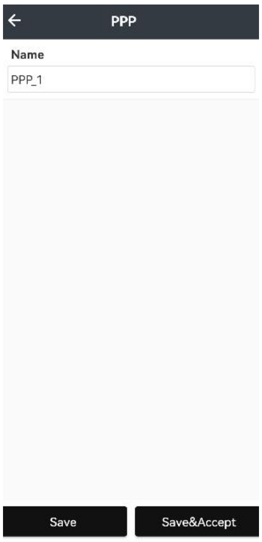
Port: input the corresponding **Port.**
Select a server: you could add a server and save it. Next time you can choose it in this interface.
Save: just save this work mode.
Save&Accept: save and apply this work mode.



Then the green LED will be flashing and the status will come from **Single** to **Fix**, which means the rover is getting the correction data.

3.2.5 PPP

Click **New** to create a work mode and choose **PPP** table.
Name: Enter a name for this work mode.



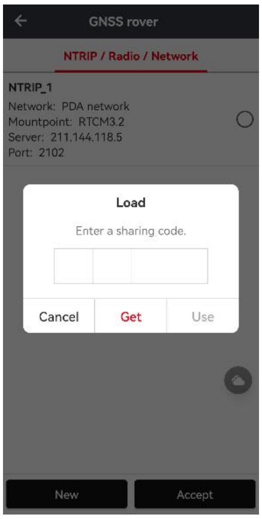
3.2.6 From cloud

Click an icon like **"cloud"** and then select **From cloud** to into cloud interface.
From cloud: Select a project, click the arrow, the project will be downloaded from cloud server, and it will be listed in **Projects** interface.

3.2.7 From sharing code

Click an icon like **"cloud"** and then select **From sharing code** to into cloud interface.

Cancel: cancel this operation.
Get: input the sharing code to get the project.
Use: click **use** to use this project.



3.3 GNSS base

Main screen of GNSS base displays the configuration of the current equipment, including the receiver setting and device operating modes. In most cases, we use the common and specific operation mode to meet the daily trial.

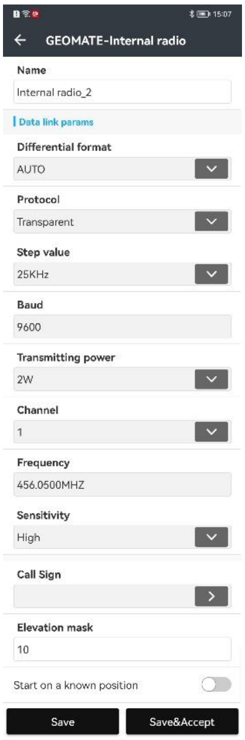
3.3.1 Internal radio

Click **New** to create a work mode and choose **Internal radio** table.

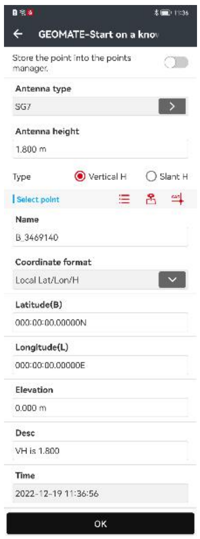
Name: Enter a name for this work mode.
Differential format: Select RTCM3.2.
Protocol: Select Transparent.
Step Value: 25kHz or 12.5kHz, the value depends on the receiver.
Baud: 9600 or 19200.
Transmitting power: Select the radio power of the base receiver.
Channel: different channel will show different frequency. And also can be customized.

GEOMATE

Frequency: normally can't be changed and if you choose **User defined**, you can change it.
Sensitivity: set as default
Call Sign: if you open it, the signal will transmit the message.
Elevation mask: 10.



Start on a known position: ON or OFF. When you click accept, you will come into an interface to input the information.



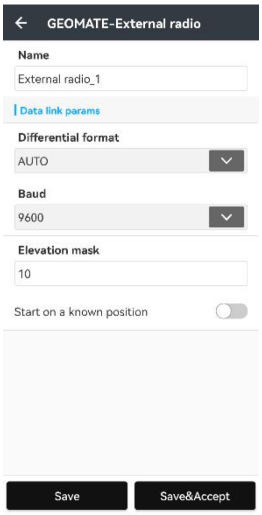
Save: just save this work mode.
Save&Accept: save and apply this work mode.

3.3.2 External radio

Click **New** to create a work mode and choose **External radio** table.
Differential format: Select RTCM3.2.
Baud: 9600 or 19200.

Elevation mask: 10.

Start on a known point: ON or OFF. When you click accept, you will come into an interface to input the information.



Save: just save this work mode.

Save&Accept: save and apply this work mode.

3.3.3 Receiver network

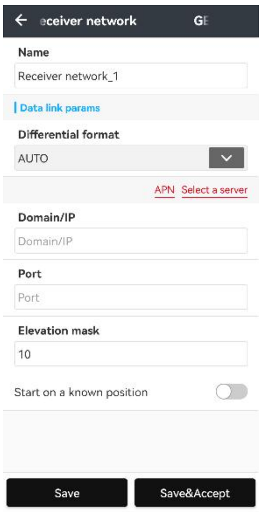
Click **New** to create a work mode and choose **Receiver network** table.

Name: Enter a name for this work mode.

Differential format: Select RTCM3.2.

Select a server: choose a server.

Elevation Mask: The angle is set for shielding obstruction. The satellites lower than this angle will not be tracked, the default is 10.

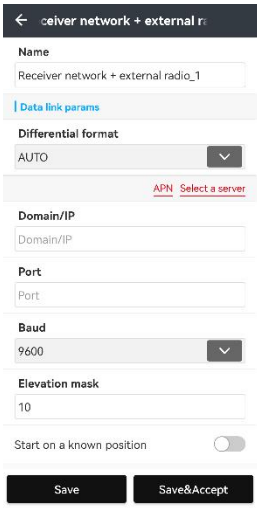


Star on a known position: ON or OFF. When you click accept, you will come into an interface to input the information.

3.3.4 Receiver network + external radio

Click **New** to create a work mode and choose **Receiver network + external radio** table.

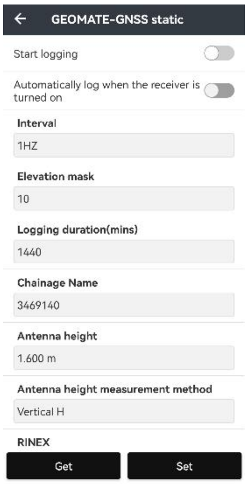
Name: Enter a name for this work mode.
Differential format: Select RTCM3.2.
APN: APN setting, you can see more details in **4.9**.
Select a server: choose a server.
Elevation Mask: The angle is set for shielding obstruction. The satellites lower than this angle will not be tracked, the default is 10.



Star on a known position: ON or OFF. When you click accept, you will come into an interface to input the information.

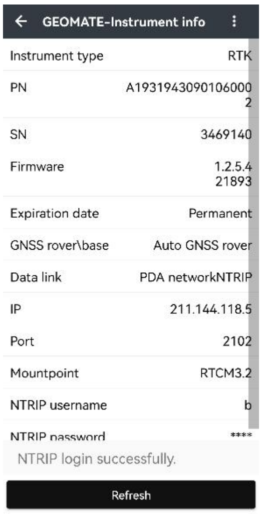
3.4 GNSS static

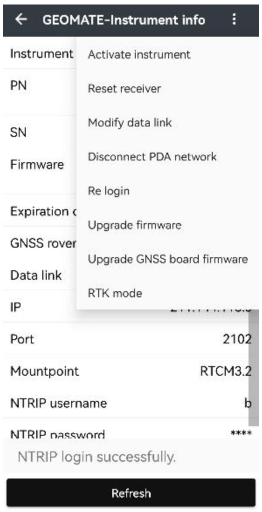
Start logging: click it to get right to edit the settings.
Automatically log when the receiver is turn on: if you choose this function, it will automatically to record the static data when it turns on.
Interval: Including choices of 1HZ, 2S, 5S, 10S, 15S, 30S and 1M.
Elevation Mask: The angle is set for shielding obstruction. The satellites lower than this angle will not be tracked, the default is 10.
Logging duration(mins): Input duration time as you wish, the default is 1440.
Station name: Input station name, the default is the SN of connected device.
Antenna Height: Input antenna height, the default is 0.
Antenna height measurement method: Including choices of Slant Height, Phase Height, Vertical Height, and the default is Slant Height.
RINEX: Choose the type of RINEX data, includes 2.11,3.0x or choose close.
Compressed RINEX: choose to compress or not.



3.5 Instrument info

After connecting between controller and receiver, MateSurvey will read out the receiver information, such as device type, serial number, expire date, work mode, datalink and so on.



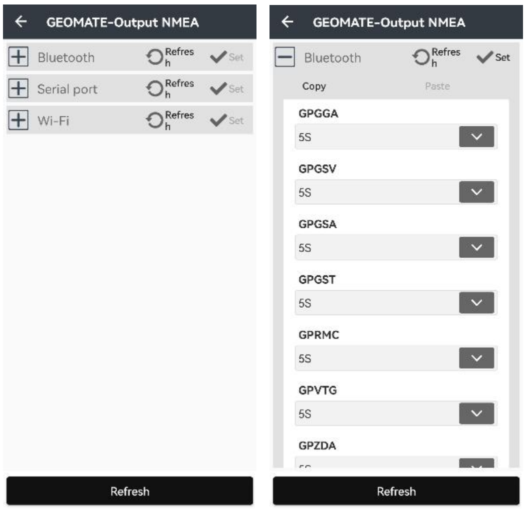


Activate instrument: Click Register then the interface of “Please Input Reg Code” will appear. If you need the code please contact with regional sales manager or dealer.
Reset receiver: Click to reset the receiver main board. Then, it will restart the receiver and star search.
Modify data link: Click to display the list of the **Work Mode** to modify the receiver work mode.
Switch radio off: if you click it, just close the radio module.
Disconnect PDA Network: Click to break network when you accept receiver/PDA network mode. Then, receiver won’t receive Ntrip/APIS messages.
Upgrade firmware: lick and choose firmware to update firmware for receiver, only support updating firmware via WiFi connection.
Update GNSS board firmware: Click and choose firmware to update firmware for receiver, only support updating firmware via WiFi connection.
RTK mode: There are three mode, n, f and a.

3.6 Output NMEA

This function is set for outputting NMEA messages for other external equipment. GNSS RTK can use Bluetooth, Port to connect receiver; smart RTK can use the Bluetooth, port or WiFi to connect receiver. When the config is modified, users need to click Set to confirm the setting is done successfully.

When users finish setting of one output mode, users can copy the setting parameters and paste it to other output mode if users want to apply the same setting parameters to another output mode.



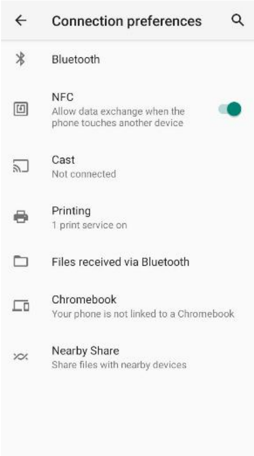
When users use receivers and set GPGGA output via serial port as 1Hz, please make sure that baud rate sets 9600.

3.7 NFC/Wi-Fi

NFC, also known as short-range wireless communication, is a short-range high-frequency wireless communication technology, allowing electronic Non contact point-to-point data transmission (within 10 cm) is carried out between devices to exchange data.

Here, NFC has three functions: 1. WiFi, Bluetooth connection; 2. modify WiFi password. 3. software start function.

(1) Turn on NFC function
Use the NFC function of hce600 Android to make a detailed description
Click [settings] - [more...], and then open NFC. Some phones the HFC are switched on by default.



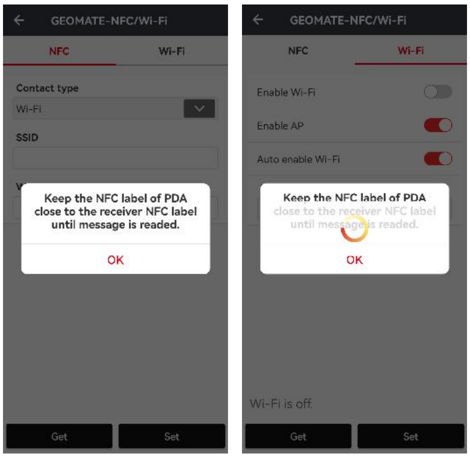
(2) Connecting the receiver

After the NFC function is turned on, lean the NFC function area on the back of the controller against the NFC logo of the receiver and touch it gently.

At this time, the system will automatically open the Bluetooth or WiFi of the controller to start the connection. If the connection is successful, there will be a sound prompt.

If the controller is the first time to connect to the receiver via Bluetooth / WiFi, just clickyou need to enter the Bluetooth / WiFi password.

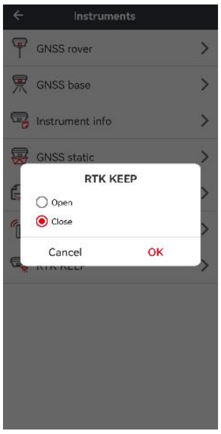
Pair the connection manually, after that no need to input again. Connection method defaults to last time.



(3) Change WiFi password
Turn on NFC / WiFi, you can change the WiFi password of the current device, and follow the prompts below.

3.8 RTK KEEP

Click open to open this function. It can make your device keep fix solution even after you loose the differential data connection. The max time can be 10 minutes.

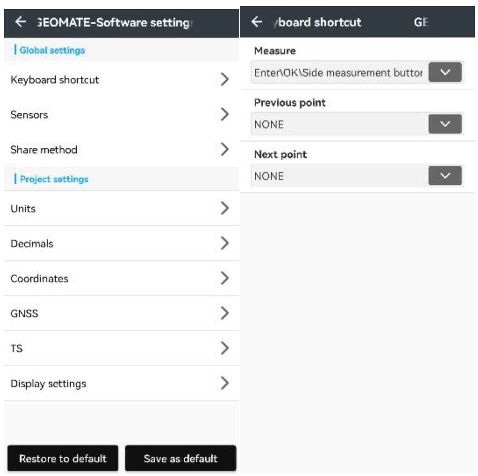

Instruments
GNSS rover
GNSS base
Instrument info
GNSS static
RTK KEEP
Open
Close
Cancel
OK

4 Software settings

4.1 Global settings

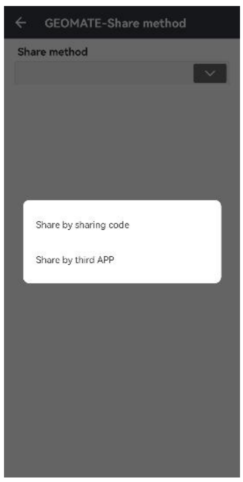
4.1.1 Keyboard shortcut

User can set different keyboard buttons for **Surveying**, moving to **previous point** or **next point**. The buttons include **NONE**, **Enter**, **Up**, **Down**, **Left** and **Right**.



4.1.2 Share method

User can use different share methods for project files sharing, for example, you can share the project files by sharing code, or share by third APP.



4.2 Project settings

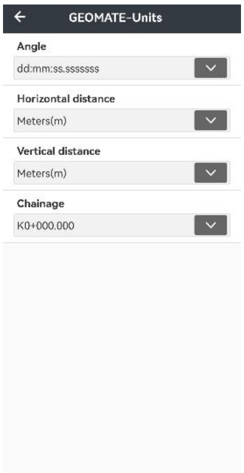
4.2.1 Units

Angle: displayed in dd:mm:ss.ssssss or Centesimal (gon).

Horizontal distance: displayed in Meter (m), U.S. feet (US) or International feet (intern.).

Vertical distance: the same as **Horizontal distance**.

Chainage: Users can choose to use chainage prefix or not. The prefix can be set as users wish. Format can be chosen from the pull-down menu.

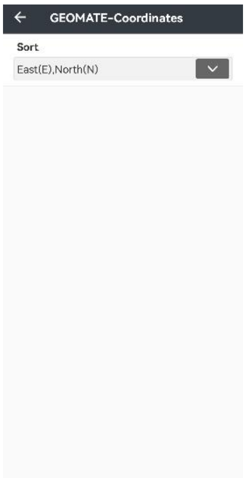


4.2.2 Decimals

Users can set the display precision of **Angle**, **Horizontal distance**, **Vertical distance**, **Area**, **Slope** (%), and **Lat/lon** (dd:mm:ss.sssss) from respectively pull-down menu. The unit of **Angle**, **Horizontal distance**, **Vertical distance** here is identical with Units set in **4.2.1**. And unit of **Area** is according to **Horizontal distance**. For example, here 4 means four decimal places.

4.2.3 Coordinates

Users can choose coordinates format between **North,East** and **East,North**.



4.2.4 GNSS

4.2.4.1 Survey

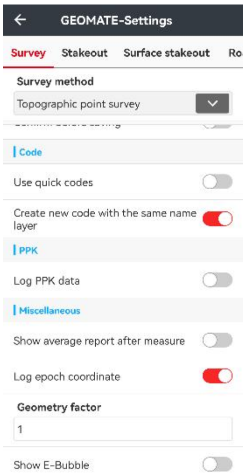
- Accuracy check

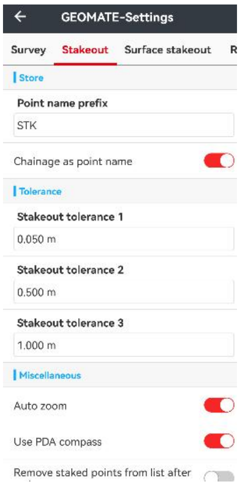
Users can modify **H tolerance**, **V tolerance**, **Diff age**, and **Max PDOP** respectively. The defaults of them are 0.030 m, 0.050 m, 5, and 4.000 respectively. Users can decide whether to "**Store only in fixed**" or not.

- Store

Users can modify **Auto increment name interval, Measurements**, and **Warn if measurement average exceeds,** respectively. The defaults of them are 1, 5, and 0.100m respectively. Warn if measurement average exceeds will be used when user set observation times to 2 or more. If the horizontal distance from current measure to the 1st measurement >0.1m (depends on user setting), the software will pop up: The rover may be moved.

Users can decide whether to "**Confirm before saving**" or not.





- Code

Users can decide to open “**Use quick codes**” or not.

Users can create new code with the same name layer or not.

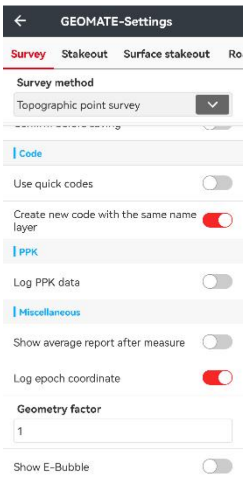
- PPK

Users can decide to log PPK data or not.

- Miscellaneous

Users can decide to respectively open “**Show average report after measure**”, “**Log epoch coordinate**”, and “**Show E-Bubble**” or not. Users can also decide on the **Geometry factor number.**

There are two ways to “**Save track**”, one is “**By time**” where the unit is sec, and another one is “**By distance**” where the unit is meter. The default is by 5 sec.



4.2.4.2 Stakeout

- Store

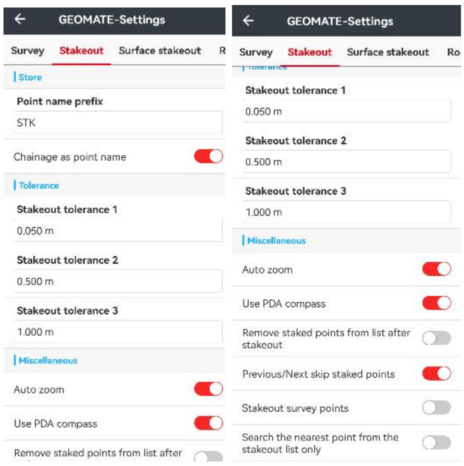
Users can modify '**Points name prefix**' and decide whether to use '**Chainage as point name**'.

- Tolerance

Users can modify '**Stakeout tolerance 1, 2, and 3**' respectively. Three different tolerances are available to be set with different degree of urgency sound prompts. The smaller the number is, the smaller the tolerance shall be set.

- Miscellaneous

Users can decide to respectively open "**Auto Zoom**" "**Use PDA compass**", "**Remove staked points from list after stakeout**", "**Previous/Next skip staked points**", "**Stakeout survey points**" and "**Search the nearest point from the stakeout list only** "or not. When opening "**Use PDA compass**", please do as the pop-up window says.



4.2.4.3 Surface takeout

Users can open "**Voice prompt**" to give voice prompt after the fill/cut within the range of tolerance.

Users can modify "**Tolerance**" to check tolerance value before store.

Users can open "**Display cut/fill in fixed solution only**" or not.

4.2.4.4 Road

Users can open "**Display all roads**" or not.

Users can open "**Stakeout main points**" or not.

If users open "**Realtime chainage as point name**", the real-time station is input as point name.

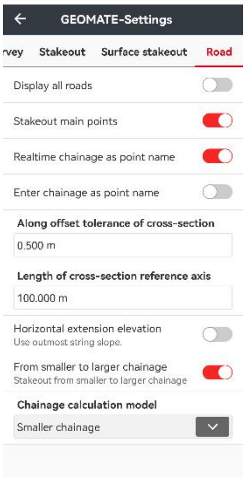
If users open "**Enter chainage as point name**", users should enter station as point name.

Users can modify "**Along offset tolerance of cross-section**" and "**Length of cross-section reference axis**".

If users close "**Horizontal extension elevation**", use outmost string slope instead of elevation would be displayed.

If users close "**From smaller to larger chainage**", please stakeout from larger chainage to smaller, otherwise from smaller to larger.

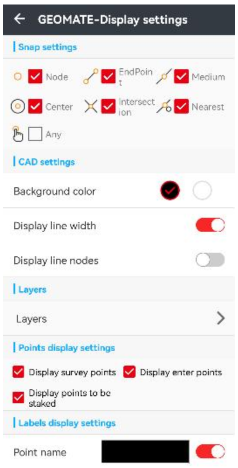
Users can choose "**Chainage calculation model**" between "**Smaller chainage**" and "**Larger chainage**". This function will be used when the software is calculating the mileage from current receiver position. If current position has two mileages on the road, display the smaller/larger chainage.

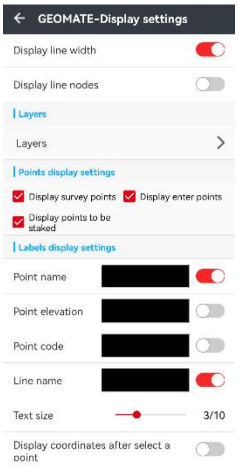


4.2.5 Display settings

Users can decide whether to display “**Point name**”, “**Point elevation**”, “**Point code**” and “**Line name**” or not. “**Text size**” can be adjusted from 1 to 10.

Users can also decide whether to turn on”**Display coordinates after select a point”** or not.





5 Survey

5.1 Site calibration and base shift

5.1.1 Site CAL

When the correction parameters of application points prompt “abnormal ratio for flat correction” or “residual value is too large”, we suggest check the control point that participate point correction input wrong or not, whether match control point or not. If users confirm there is no error, please continue operations.

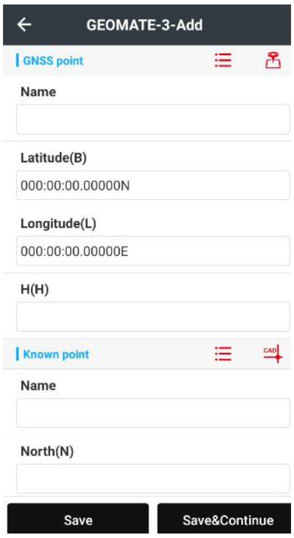
Assuming there are some known points K1, K2, K3, K4, and find the field position of known points. After that measure corresponding points 1,2,3,4 in the case of the base station does not move.

Site calibration: Click to enter point calibration interface.

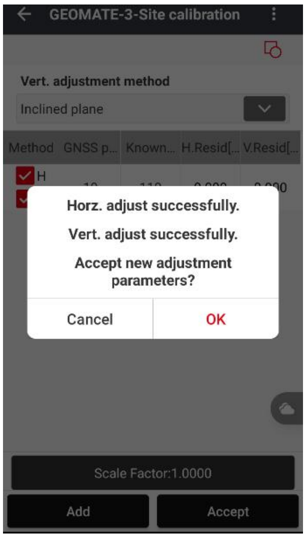
Vert.adjustment Method: Include Inclined plane, Constant adjustment, Surface fitting. Default plane fitting method is Inclined plane.

Add: Click to select correspond GNSS points and Known points. Select **Horizontal + Vertical Calibration**. The best choice is to choose 3 couples of points based on actual situation.

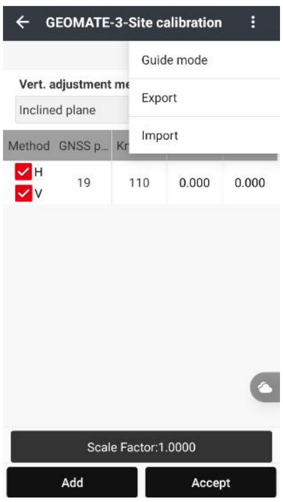
user can select Known Point or input Known Point coordinate. Then click **NEXT** until all necessary points have been selected.

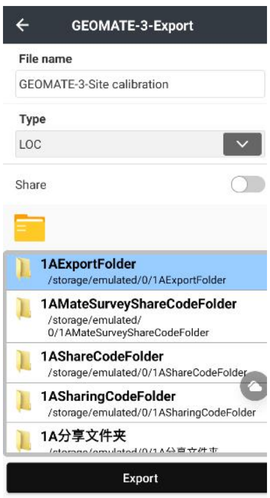


Calculate: Click **Calculate**. The software will prompt "Horz.adjust successfully". After that click **OK**, it will make current calculated correction parameters apply in the coordinate system which can affect into the whole project.



Click **Export/Import**, so users can export .Loc file from current controller/project and import the .Loc file into other controller/project.

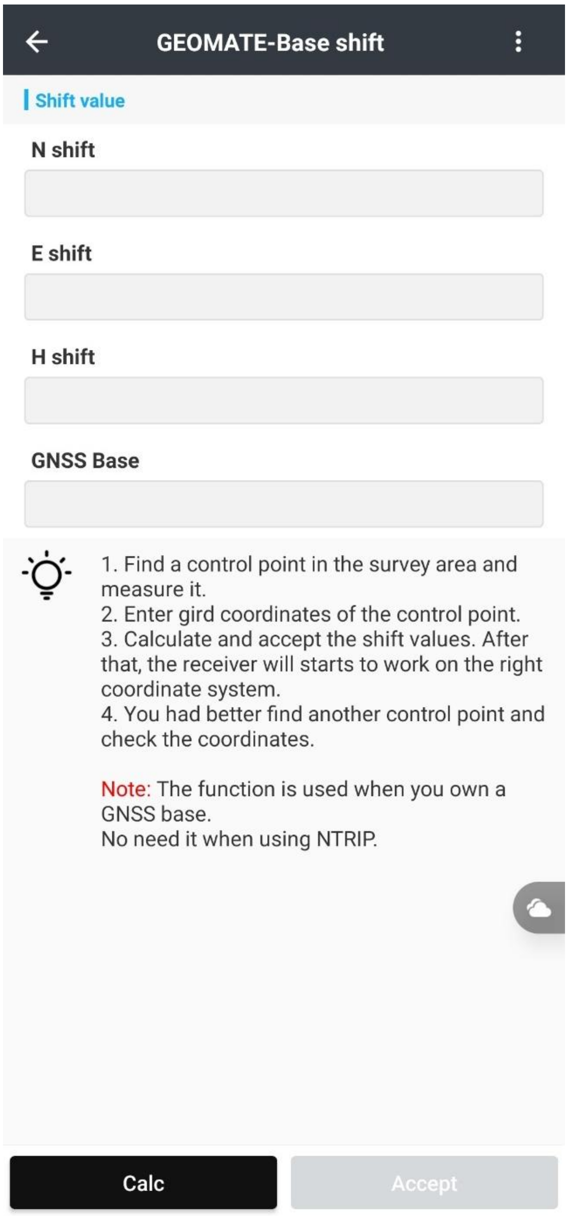




5.1.2 Base shift

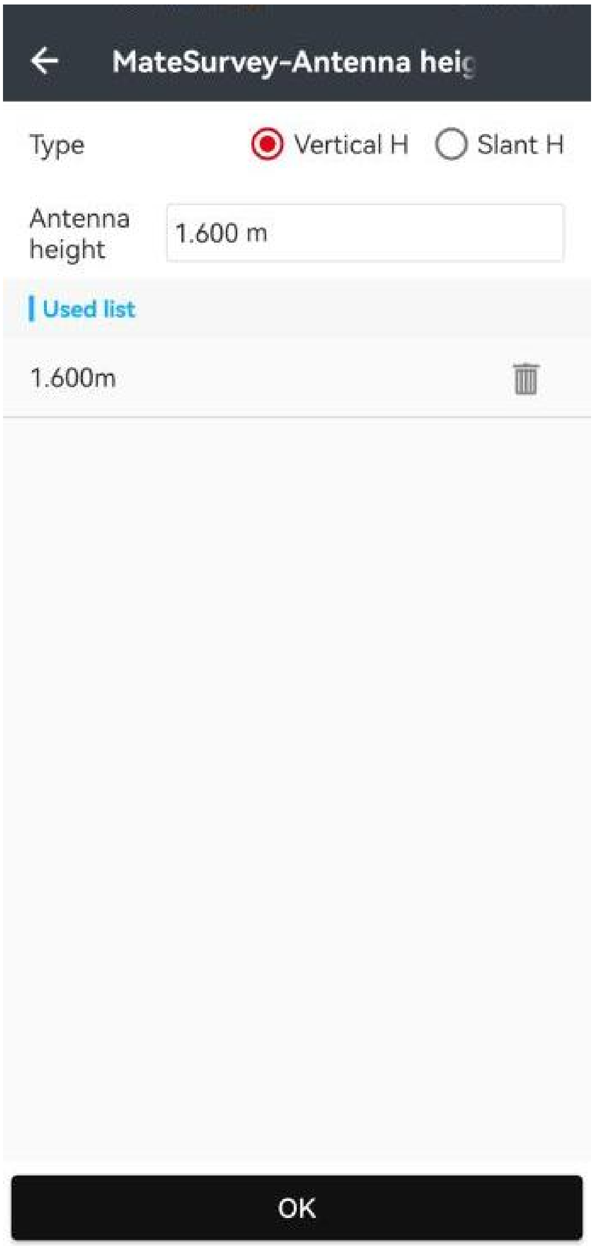
When moving or setting up the base again in **Auto Base** mode, **Base Shift** is required to ensure all the current points are belong to the same coordinate system as before.

Calc: Click to enter base shift interface. In base shift Interface, click the icon beside Measure Point to select a current point surveyed at a control point, click Next to select the corresponding control point. The calculation results would show automatically. Then click **Accept**. The software prompts "Accept base shift Parameters?" click **OK**, then the software prompts "GNSS Base and related points were shifted successfully, open points manager?". Click **OK**, the point library is opened and the plane coordinates are changed because shift parameters have been applied to all the points surveyed under this base.



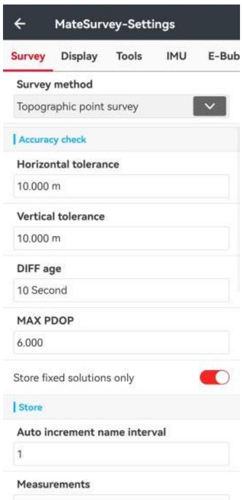
5.2 Map Survey

Users could select the **type** of antenna height and input the value. Click **OK**.

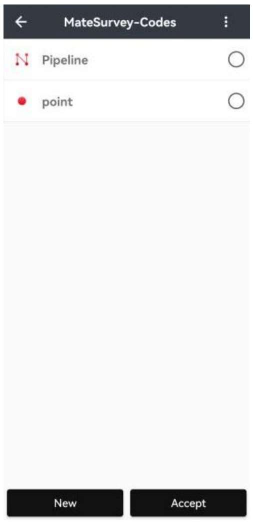


Vertical H: The height from ground point to the bottom of receiver. When using range pole, the vertical height is the pole height.
Slant H: The height from the ground point to static measurement tick mark (X91+ is the blue rubber ring, smart receiver is to the auxiliary H.I. tool) of receiver, usually this height is needed when setting up the receiver on a tripod.

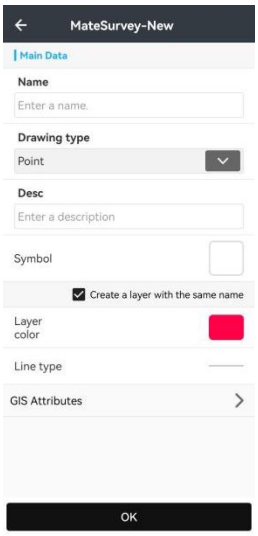
In survey, users could **manually** input the point name or let the system create it **automatically** according to name step size.



Users could select **survey type** between point and line.

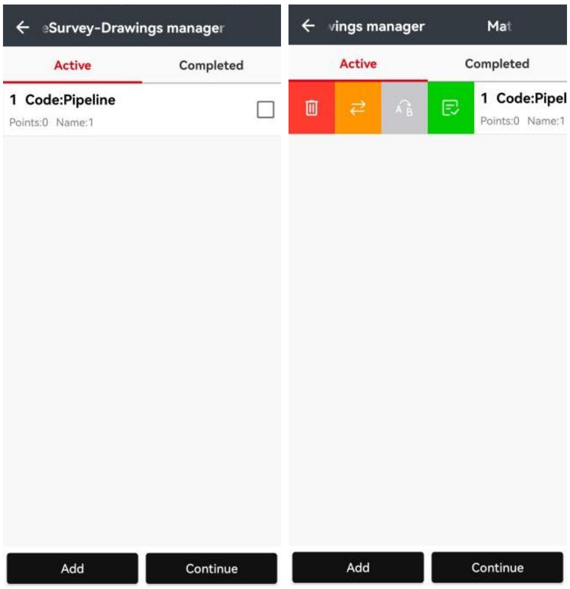


Uses could add the new type.

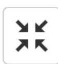


In line survey, if users open **Confirm before saving**, they should give the line name after the start point is measured. In next points, they could name new line name or choose from the existing list before saving it.

 icon opens the line manager. Users could select a line to continue drawing or add a new line. Right slide to get more operations: delete, complete, invert, and rename.

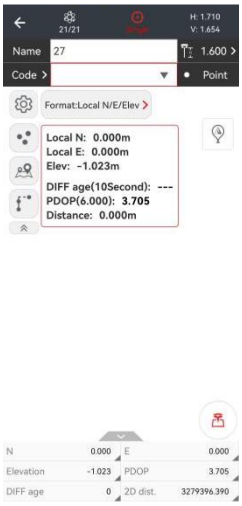


 icon defines the map type to display.

 icon moves the current point in the center of the screen.

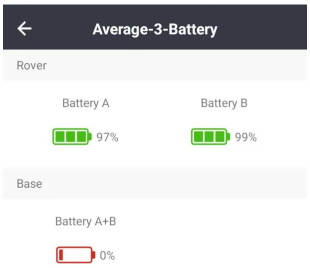
 icon is the full-screen display button.

 icon opens four cells to display. Users could select in each cell what they want to display.



 icon is the same like in Error! Reference source not found.Error! Reference source not found..

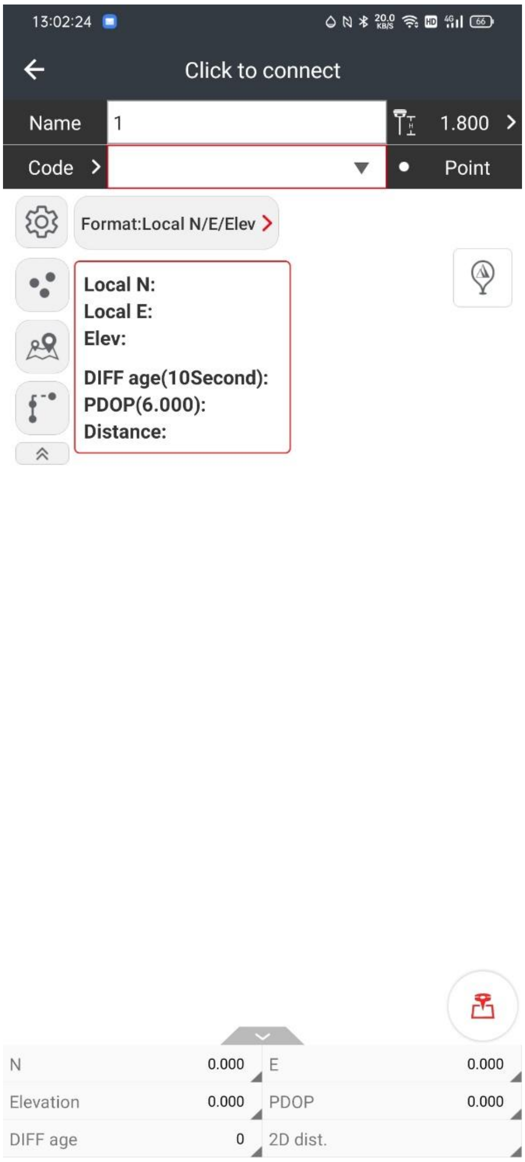
icon shows batteries condition of the Rover.



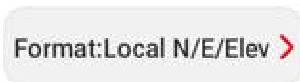
5.3 Point survey

5.3.1 Interface of the Point Survey

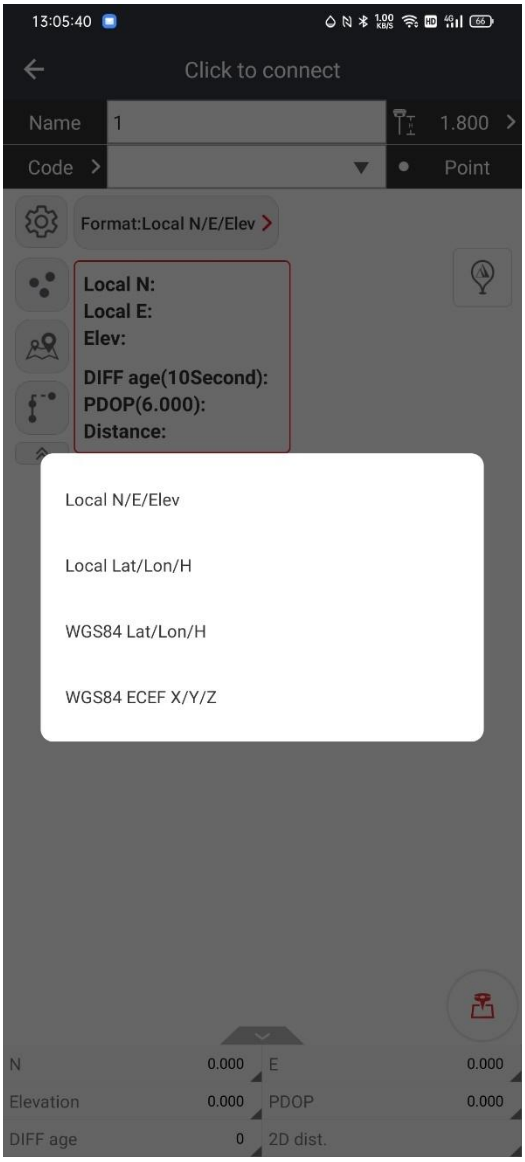
The antenna height, point name, and code parts are the same as those in map survey. Here users could also add a **description** of the points （Code）.



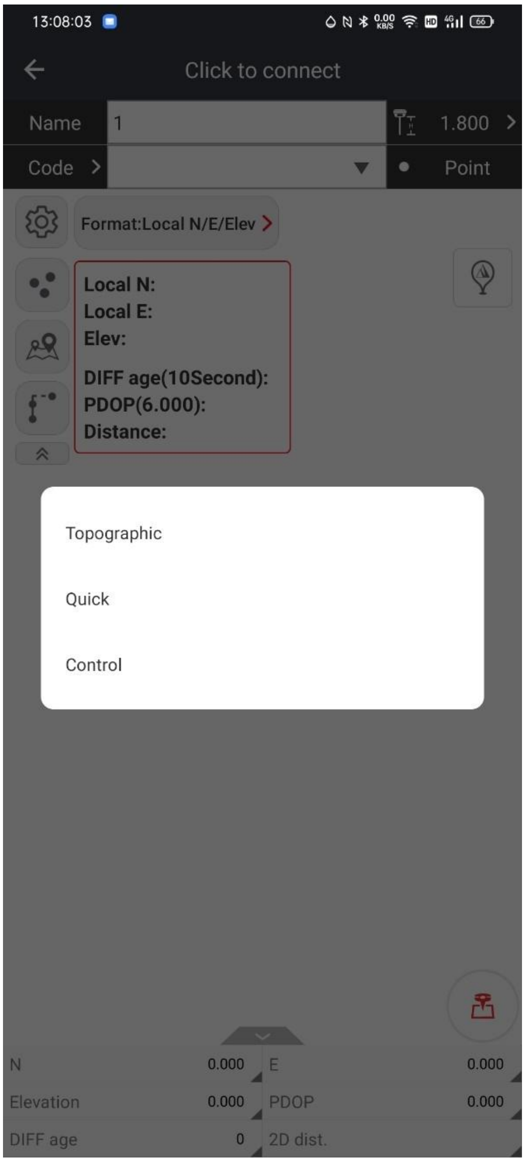
Users can click the gear icon  to change the **settings** in the survey of point.

User can also change the **format** of points by clicking Fomat button 

.

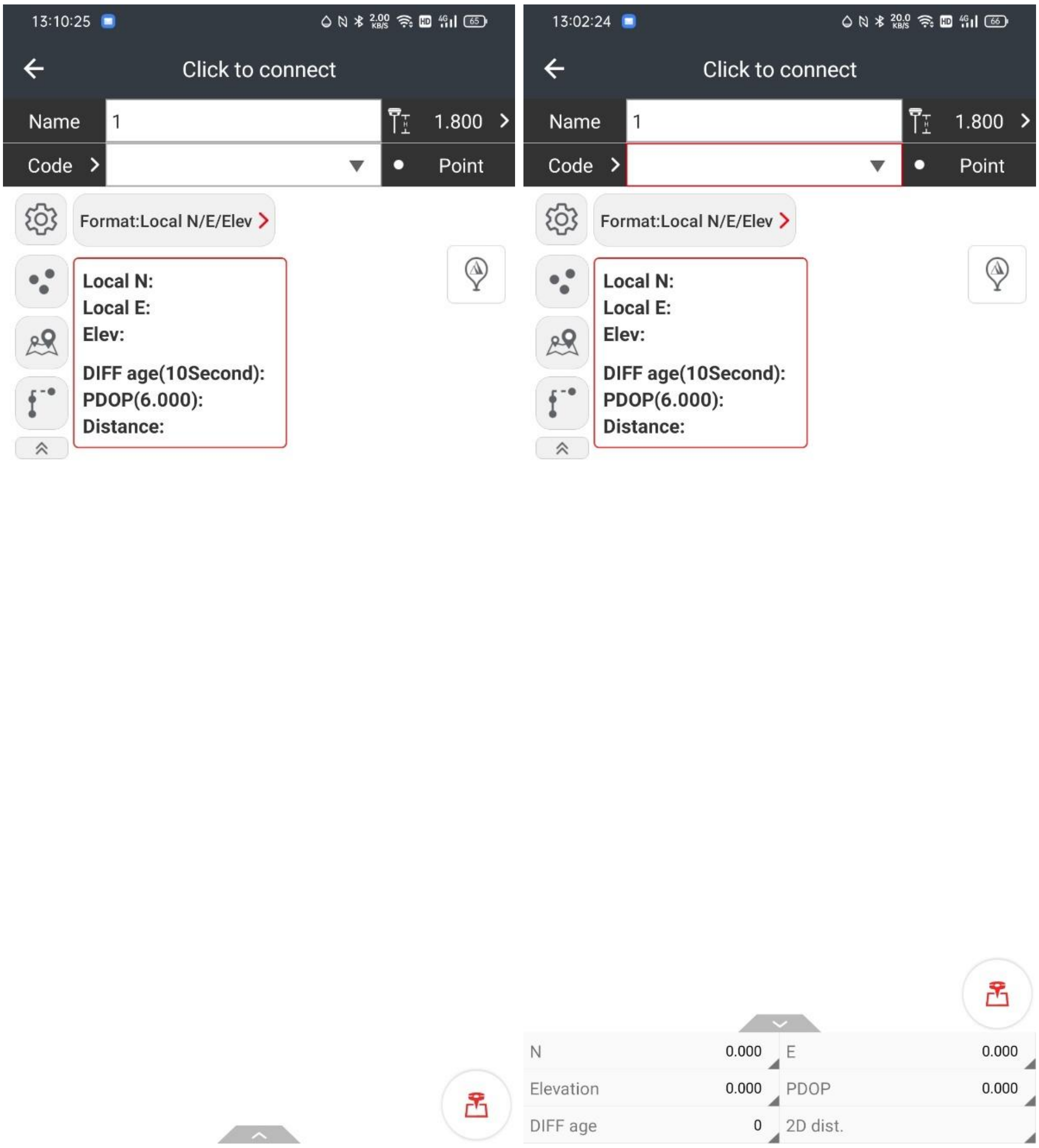


Users can also change the different way of surveying the point by clicking .

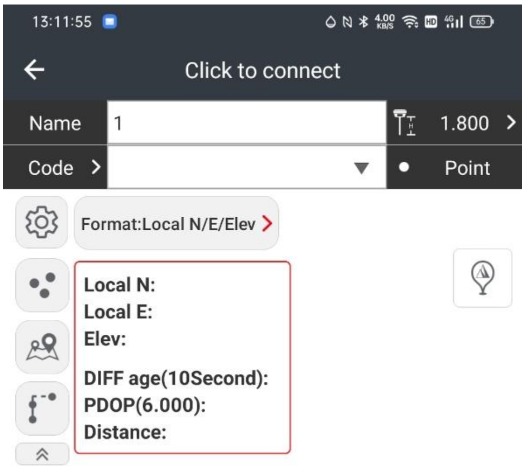


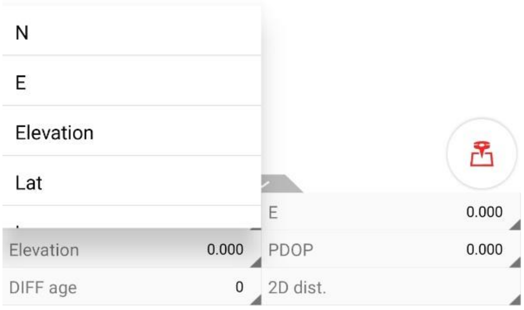
Users can locate where they are using this button  .

Click the , you can hide or show the display of the point parameters.



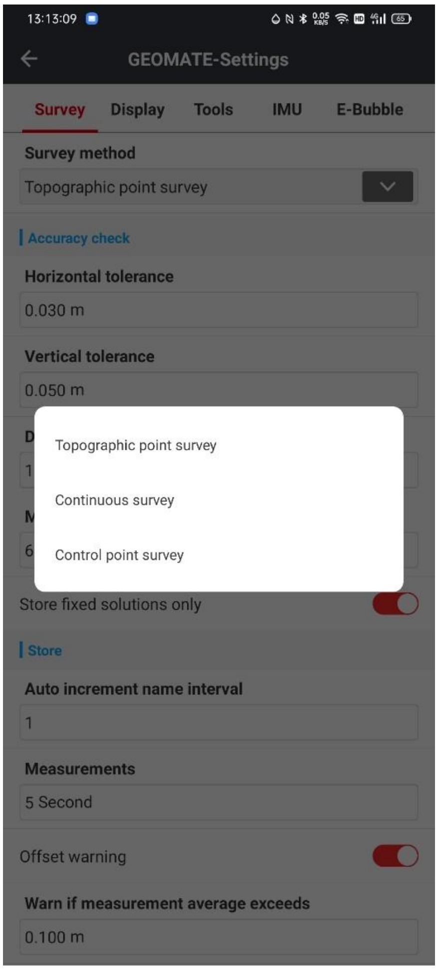
Click the parameters to change the displayed parameter.





5.3.2 Settings

When we want to change the detailed settings of the point survey, you can click the gear icon .

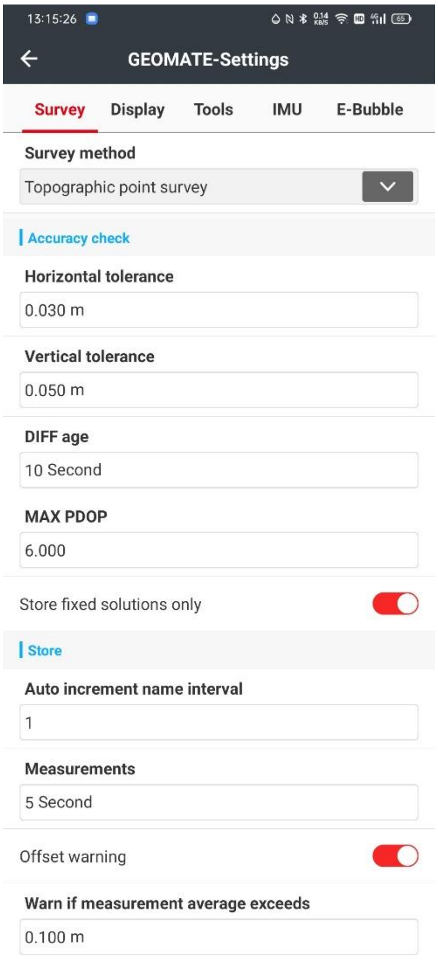


Survey: when doing the survey job, you can choose three different survey methods: Topographic point survey, Continuous survey and the Control point survey.

1) Topographic point survey:

   when you choose this way, change the horizontal and vertical tolerance to the number that you need. Also, can change the maximum differential delay. If you only want the fixed data and high accuracy data, you can only store the fixed data.

GEOMATE



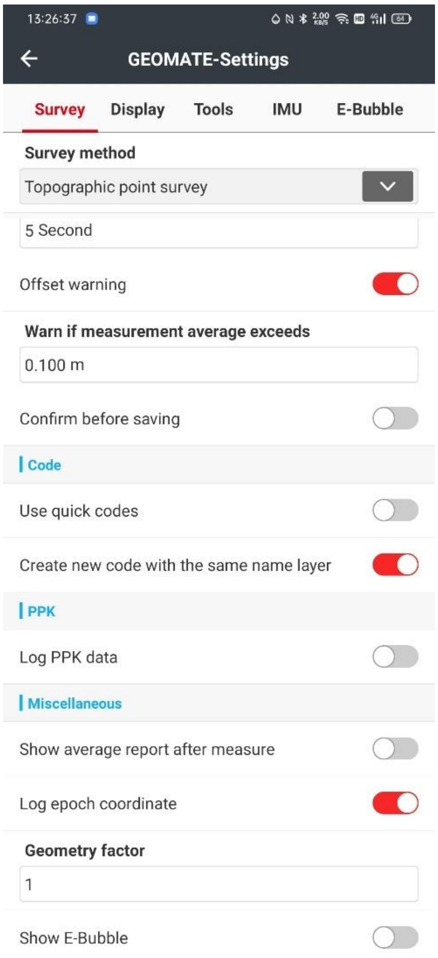
If you change the Auto increment name interval number, when you finished a survey of point, the name of next point will be automatically increasing the number that you set.

Measurements: the time that you survey a point.

Offset warning: warn if measurement average exceeds

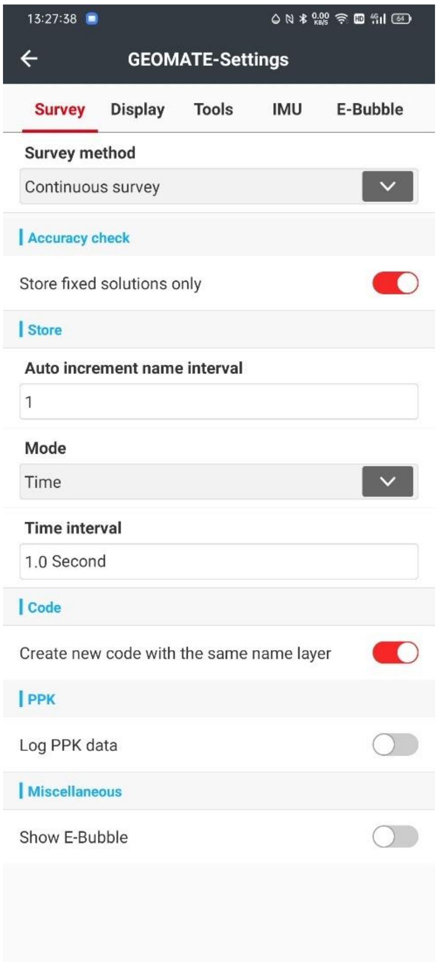
You can also choose to create new code with the same name layer. Also, can log the PPK data when you measure a point.

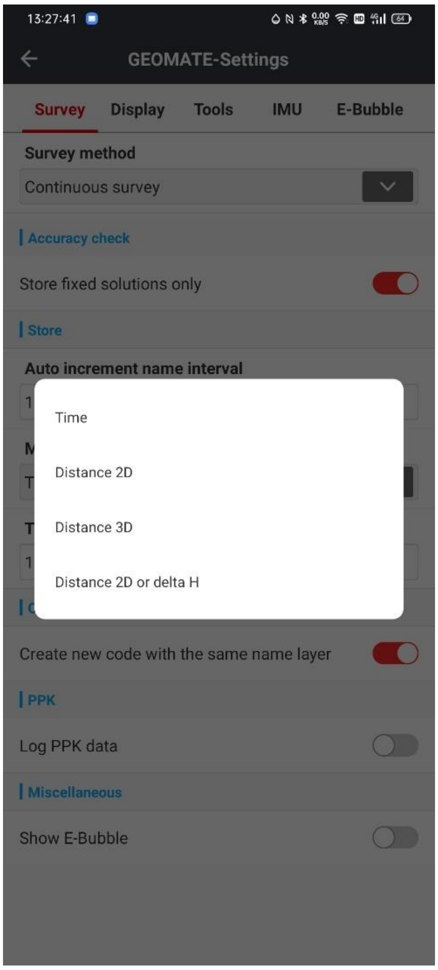
After the measure, you can choose to show the average report and log epoch coordinate for the point.



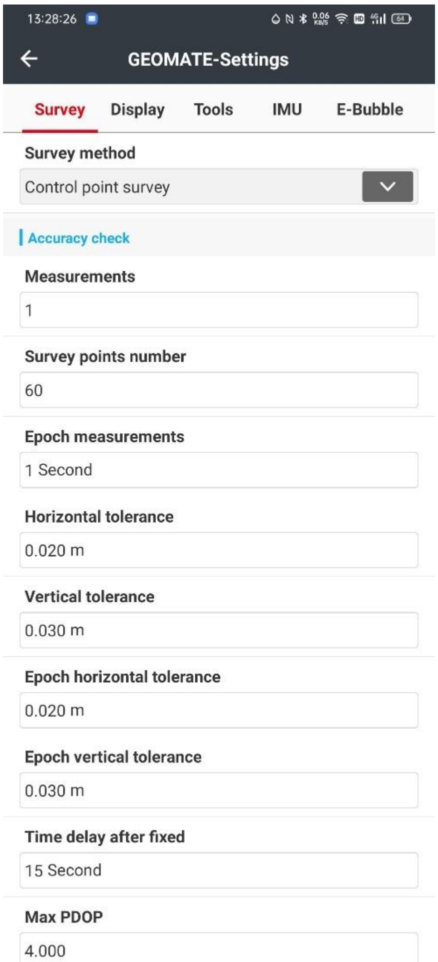
2) Continuous Survey:

you can change the measuring mode from time to distance2D, distance3D or Delta H. As you change, it also changes the principle of interval for recording data.



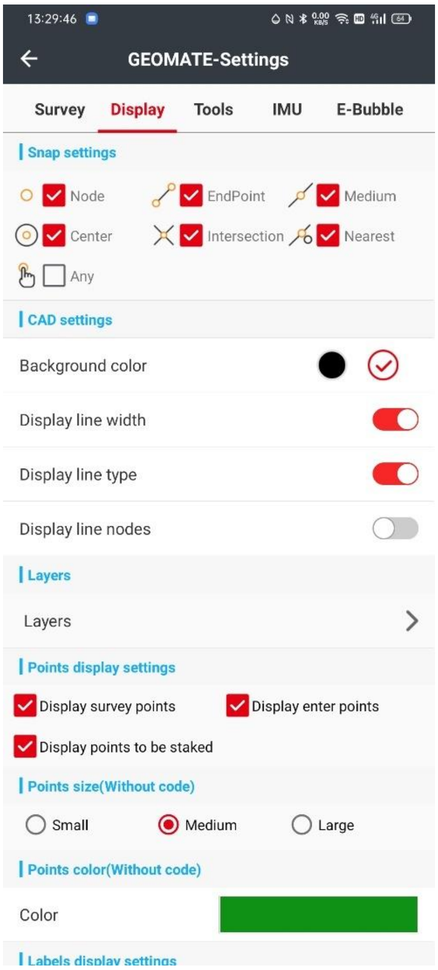


3) Control Point Survey:

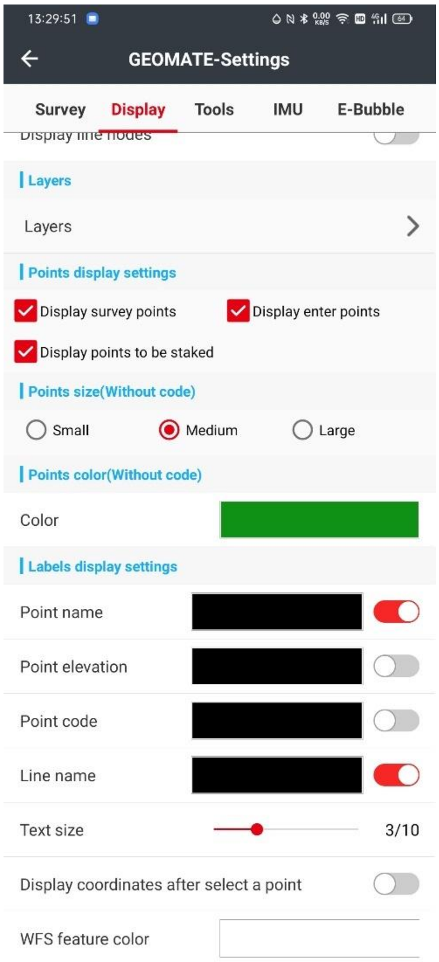


Horizontal/Vertical Tolerance: Determine the accuracy of the received data.
DIFF Age: Acceptable differential time.
MAX PDOP: Maximum position accuracy.

(1) **Display**: any display options will be in this interface. You can change the snap settings to choose the point you want. The background color also can be changed to black or white.



If you want the display of the line width and the line nodes, you can turn these buttons on. When opening a CAD map, you can change the unit and the coordinate system.

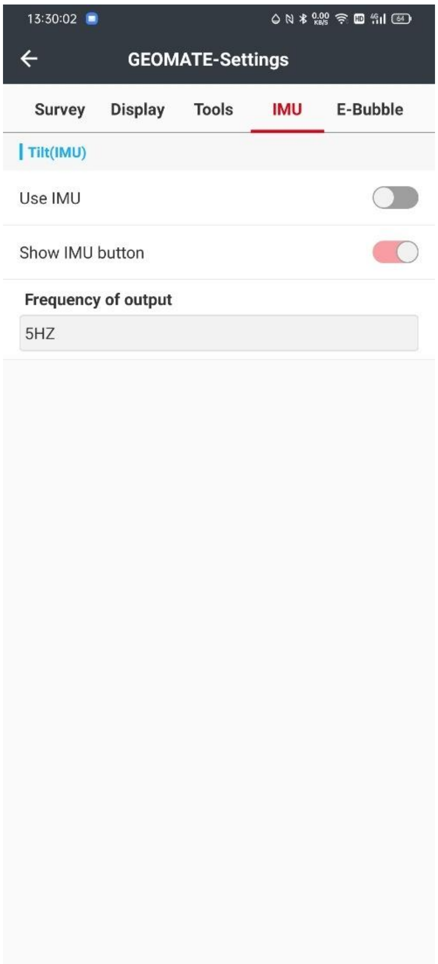


Different layers can be created, and you can choose to display different type of points and change the display of labels.

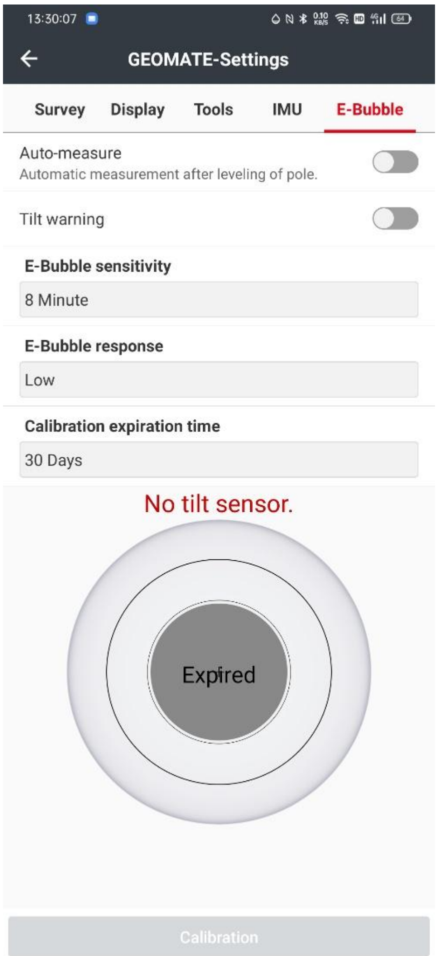
(2) **Tools**: Select and unselect different items, then put it on the left side of the point survey interface.

CAD View: Open this data base in the CAD view.
Points Manager: At this manager, you can import, export and add points you want. Also, we can choose the points you want to stake.
Offset Survey: Choose your reference point, generate new points according to your offset, azimuth, or the way two points meet
Map Survey: Open this points base in the map survey interface, so you can change the auto center or the follow mode.

(3) **IMU**: you can choose to use the IMU or not and can activate the IMU button and choose to show the button or not. if you want other frequency, you also can change the outputs option.



(4) **E-Bubble:** If you turn on the auto measurement button, after the leveling of the pole, it will immediately measure automatically. The E-bubble sensitivity and response will affect the tilt warning, when the tilt reach the limit of the sensitivity, it will response.

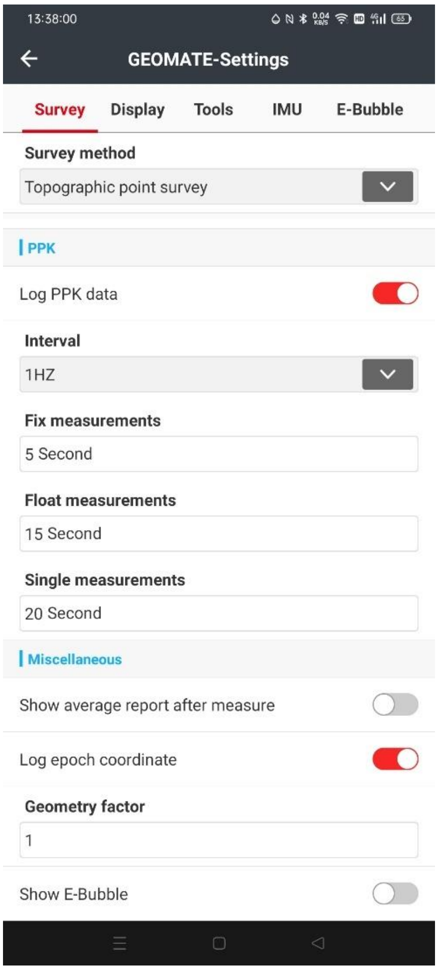


5.3.3 Control survey

Control points would take **long** time to observe, but it could provide high precision result. Users could adjust parameters for survey and click **Next** to start control survey. After measuring is finished, users could check its attribute, then click **OK** to finish.

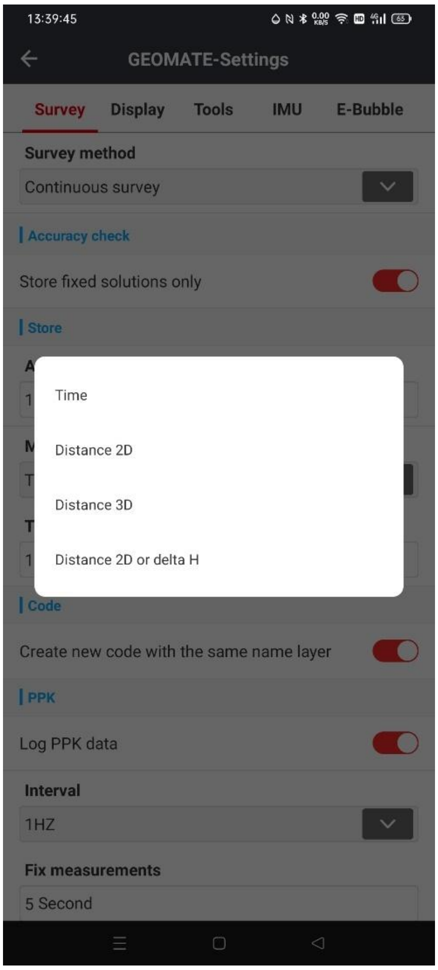
5.3.4 PPK survey

Users could choose **Interval**, **Elevation mask**, and **Observation time** as they wish. Click **Next** to enter PPK mode. Click PPK icon to start PPK measure.



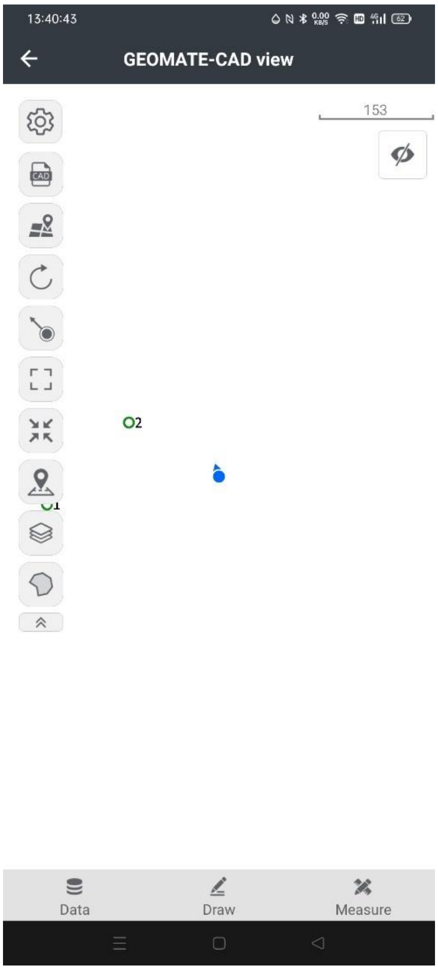
5.3.5 Continuous survey

Continuous survey automatically accords to a preset fixed **time period** or **space distance**. There are four modes to select.



5.4 CAD view

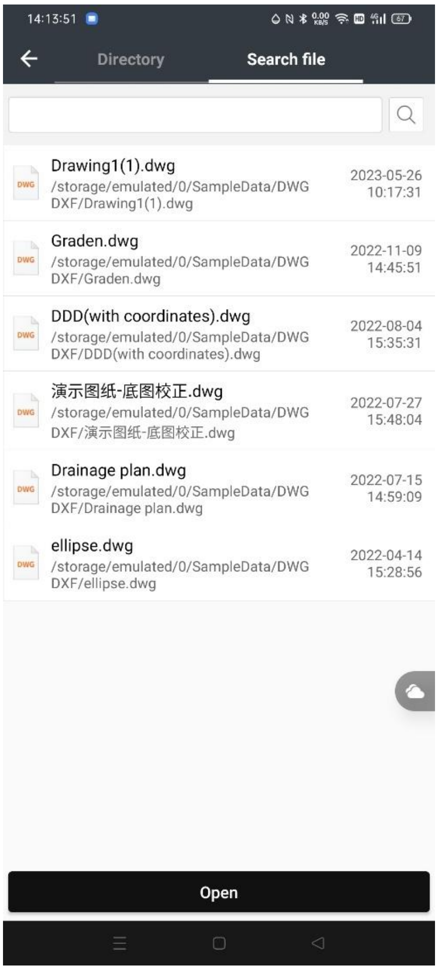
Open the software, select the CAD view module to view the CAD file.

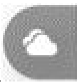


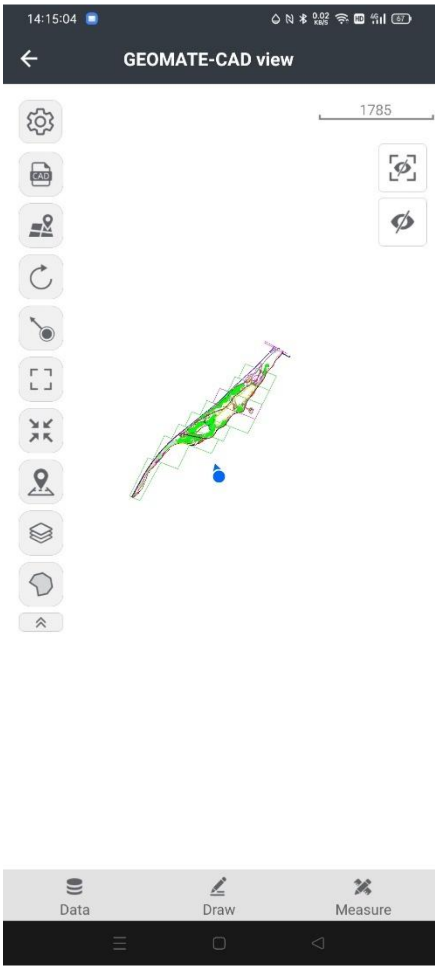
5.4.1 Open CAD file

Click  icon to open the file manager

select the file to be opened, and then click **open**.



click  to choose **From cloud** or **From sharing code** to upload the file to be downloaded.



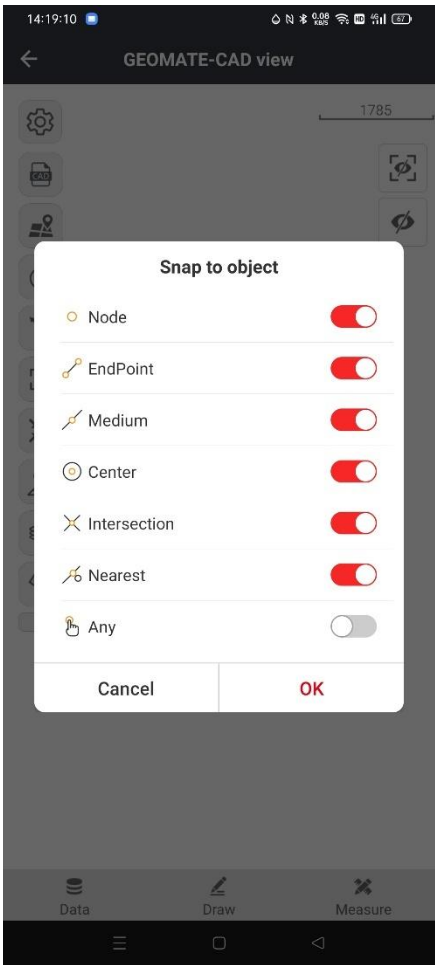
5.4.2 Side bar

1)  Load the map

2)  Refresh the CAD file

3)  Snap to object

Users can long press the  button to modify the snap settings.

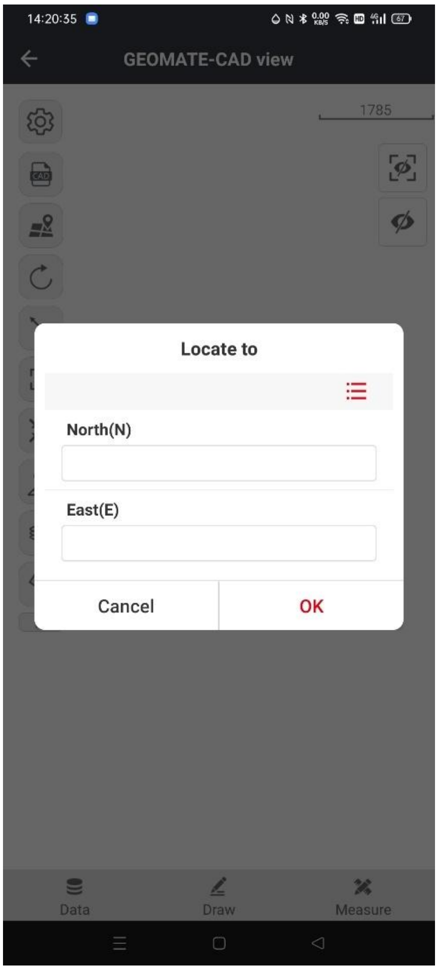


After snap a object you can click  this button to jump to stakeout function.

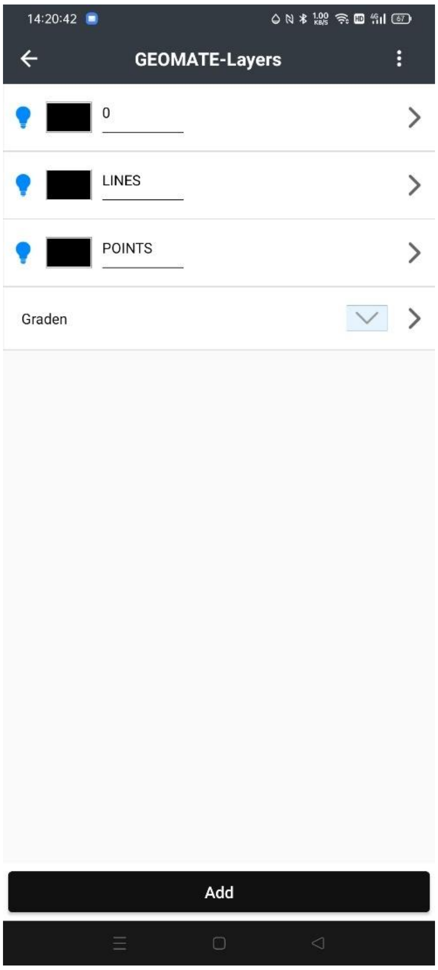
4)  Full data display of collected data and CAD graphics

5)  The current position is centered

6)  Point Stakeout button, directly input point coordinates



7)  Buttons for layer display control



8)  Set button

You can set the **Snap settings, CAD settings, Layers, Points display settings, Labels display settings**.

5.4.3 Tools

There are three modules at the bottom of the interface: **Data, Draw, Measure**

1) Data

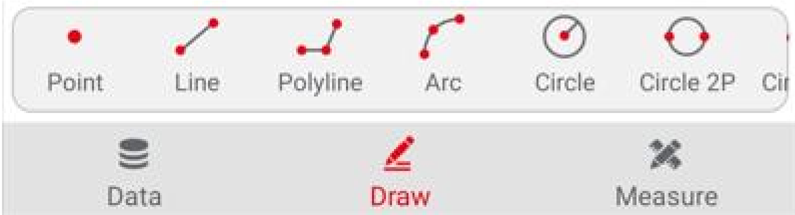
: Select an object or an area, and delete them from the CAD file.

: Export the CAD file in DXF format, and can choose the Filter type of Survey, Enter, Control, Base.

: Layer display control.

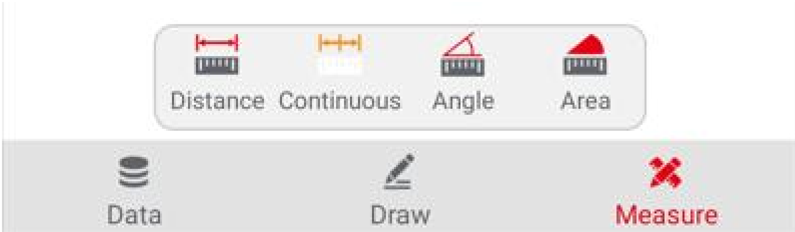
2) Draw

Can draw the Point, Line, Polyline, Arc, Circle, Circle 2points, Circle 3points, Text,



3) Measure

Can select the points and measure their distance, angle, area.

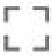


Open the software, select the survey module and click [CAD Stakeout] to enter the CAD Stakeout. When there is no stakeout task, the upper left navigation area displays NEH coordinates by default.

 Snap point button

 Point Stakeout button, directly input point coordinates

 The current position is centered

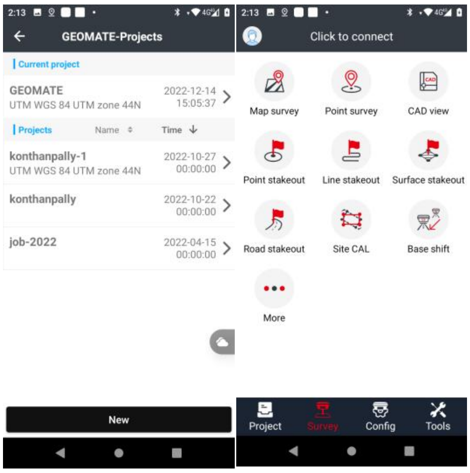
 Full data display of collected data and CAD graphics

 Buttons for layer display control

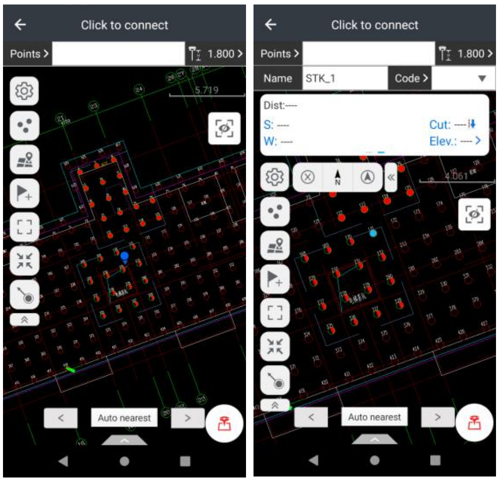
 Explode polyline and block

5.5 Point Stakeout

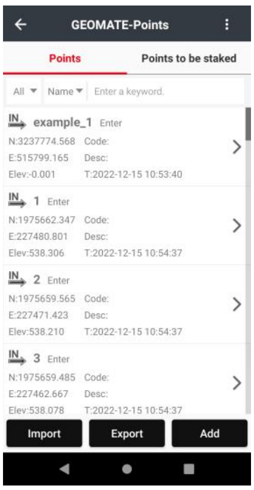
First of all, we need to open a project or create a project before we start the point stakeout



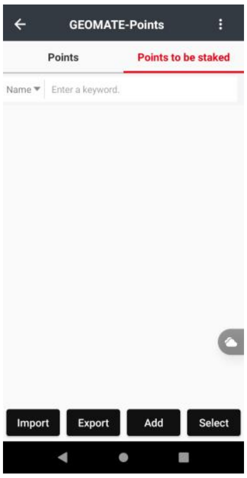
In this case, we will use a CAD file as simple.



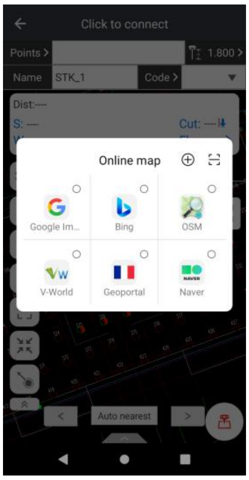
From **points library**: Select a point from points library ,you can also add a point manually, or import/export the point file in this faction .



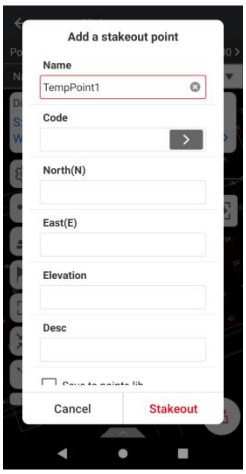
From **Stakeout points**: Select a point from stakeout points library .



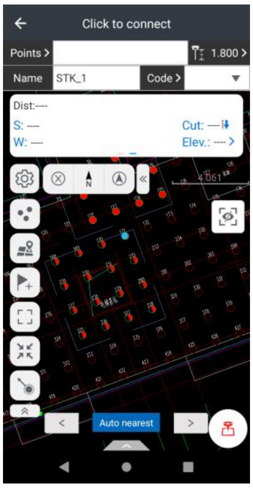
Online map: Users can choose the online map which they want to use as background.



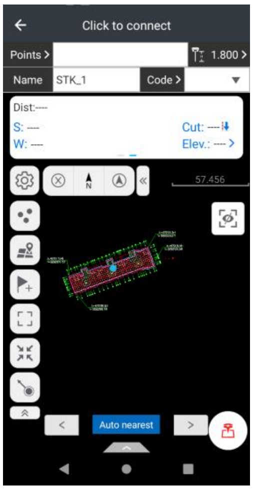
Enter a point: Users manually input the name, code, and coordinates, then click **Stakeout**.



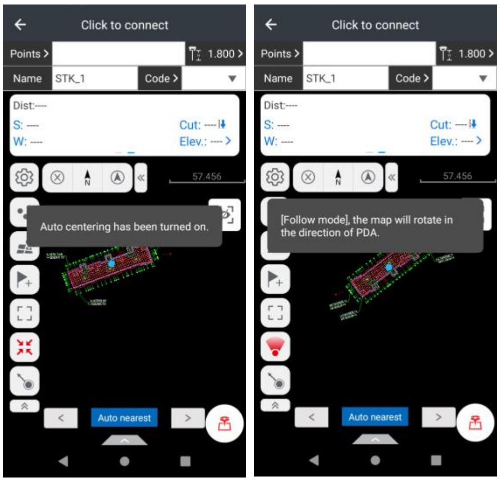
ATUO nearest point: The **ATUO nearest** button is to rank points according to distances.



Full view: Users can view the full map.



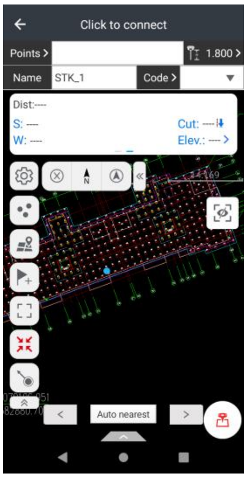
Center: Users can click it once to make the map always heading north, click it twice the map will rotate in the direction of PDA, click it three time the Auto centering will be turned off.



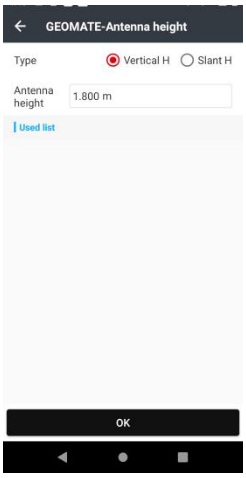
Snap: Users can choose a point from the map by the arrow.

Click the compass icon will show distance and direction to the point.

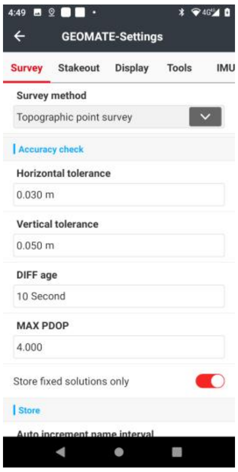
Click the survey button to stakeout the point.



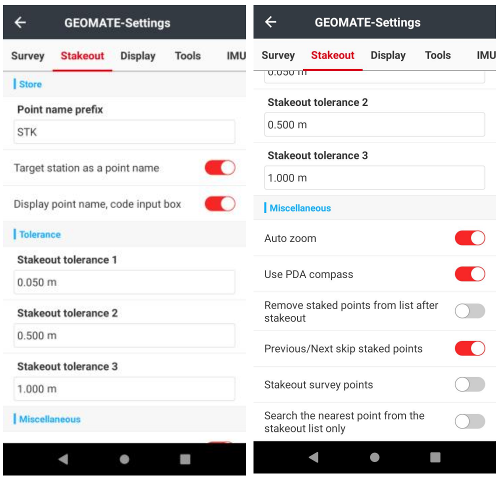
Users can set the Antenna height in Antenna height.



Click **Settings** icon to open the settings.

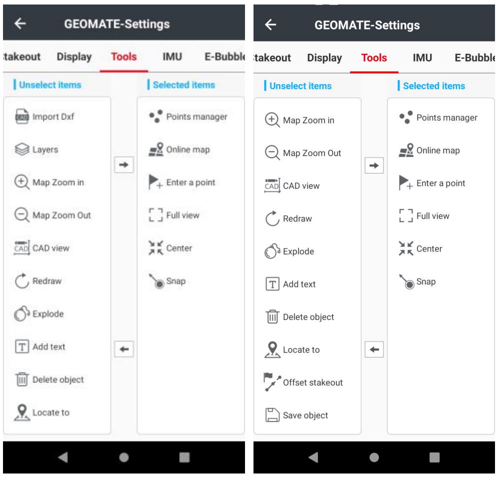


Stakeout settings: Users can change the store settings, the tolerance settings and the miscellaneous settings in this part.

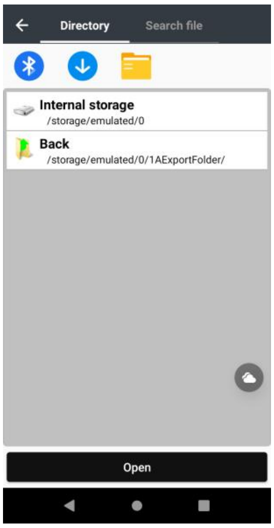


Tools

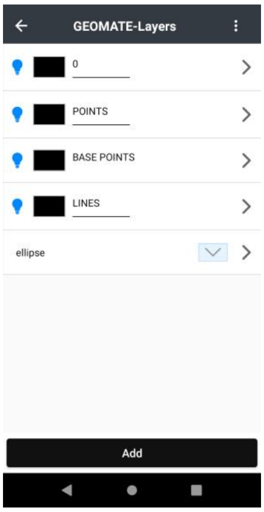
The **Tools** setting includes all the tools, selected and unselected.



Import DXF: Users can import the DXF flies from memories.

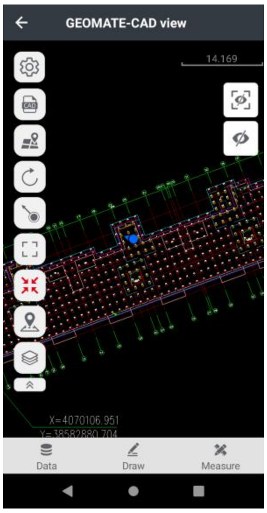


Layers: Users can show/hide the layers .

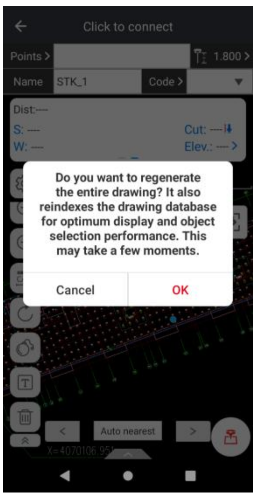


Map Zoom in/out: User can zoom in/out the map by these two tools.

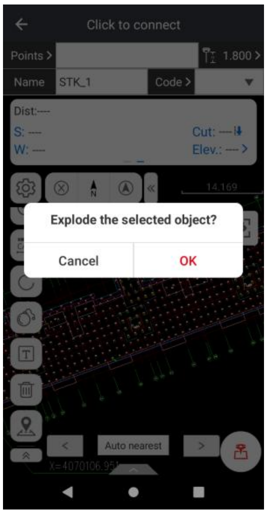
CAD View： Users can edit the CAD map in this tool.



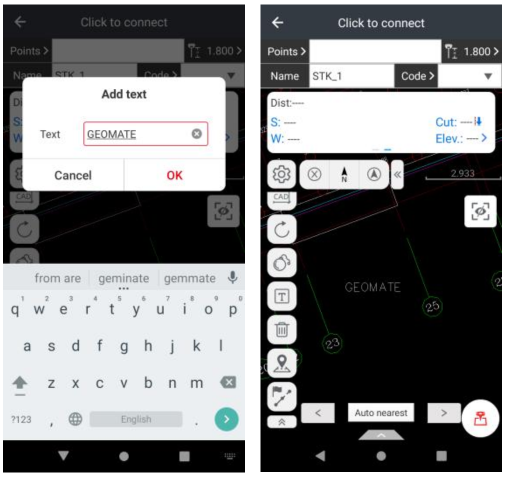
Redraw： User can regenerate the drawing. Click **OK** to redraw the map.



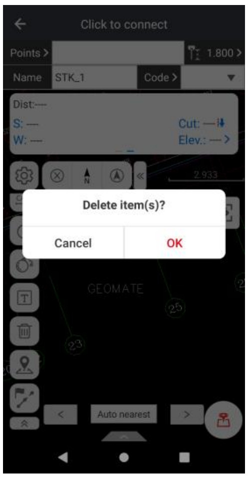
Explode: Users can break a compound object into its component objects. Click OK to explode the selected object. It’s the same command in AUTOCAD.



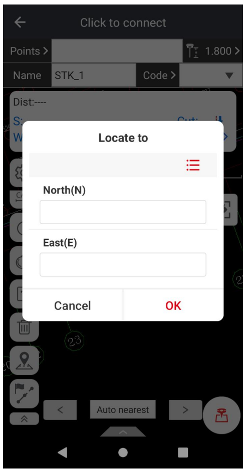
Add text: Users can add text to where they tap the screen.



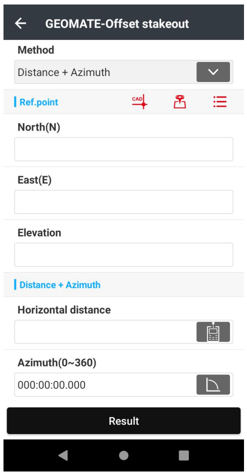
Save/Delete object: User can save or delete the choosed object



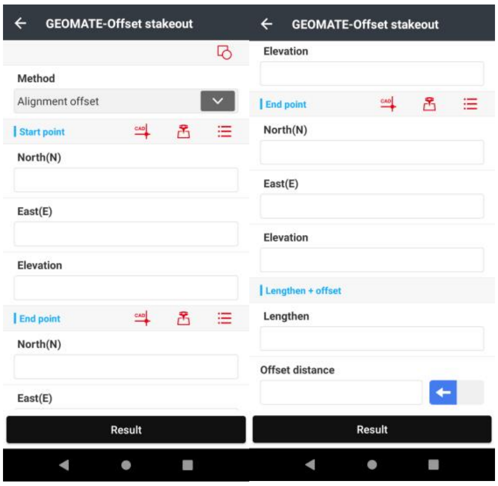
Locate to: Users can locate the screen center manually.



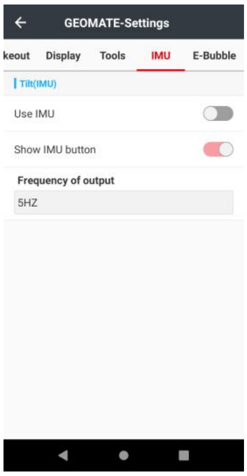
Off set stakeout point: Users could manually input coordinates, pick from the map, instant survey, or select from point library. After inputting distance and azimuth, click **Result** then input the **name** of the new point. Click **OK**.



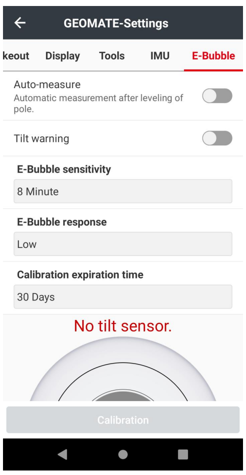
Users can also choose the Alignment offset function to stakeout point by entering lengthen and offset distance.



IMU： Users can change the IMU settings.（The device must have the title sensor）

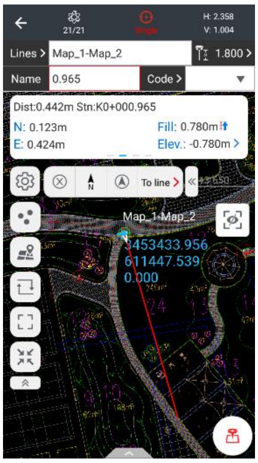


E-bubble: Users can change the E-bubble settings. To use this function, the device must have the title sensor



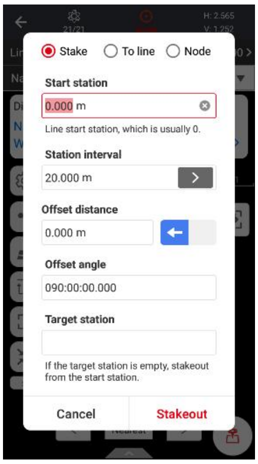
5.6 Line stakeout

Lines: Users can choose different types of lines in line management.

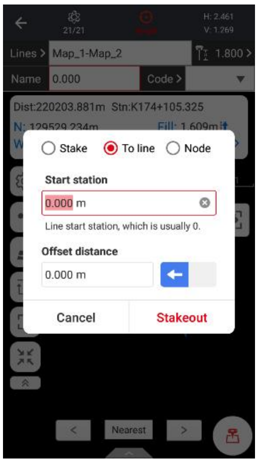


Stake: Click the stake button can choose the way how we stakeout the line.

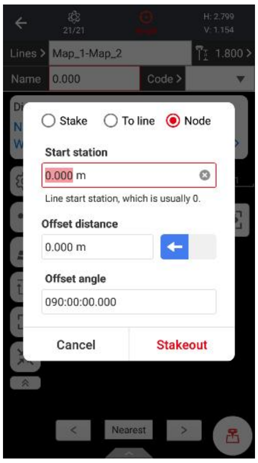
Stake: In this mode, users can stakeout the line stake by stake. Users can also change the parameters, Start station, Station interval and the offset settings.



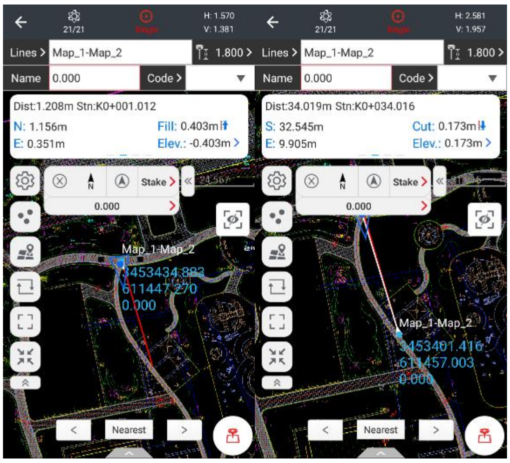
To line: Users can stakeout any point on the line in this mode. Users can also change the Start station and the Offset distance.



Node: The system will automatically choose the spatial point of the polygon or the line. Such as the center of the circle, the corner of the polygon and the line.



Invert: Click the button will switch the start and end point off the line.



Move as the instructions say and users can switch between map mode and compass mode for convenience. Click the survey button to stakeout the item.

icon is to the CAD view function.

6 Road

6.1 Road stakeout

LandStar Roading is a module that allows to create and manage road design data and perform all the necessary stakeout operations without to use point coordinates but by using original design data. The user is free to stakeout and to have road design information at any stations.
Road design data can be created or be imported from LandXML format and the complete design can be managed directly on the controller; it is possible to manage more than one axis at the same time and all design data are displayed in the plan view and cross-section view.
It is possible to work in two different ways:
Cross-sections at specific stations: in this case at any stations the interpolated cross-section is calculated.
Cross-sections templates: one or more cross-section template can be applied along the center line; cross-section template can be fully customized by the user by defining the cross-section shape and also additional information as superelevations and widenings.
Is is possible to stakeout the road design data and sideslopes at any station and with any offset; the point to stakeout can be easily specified on the cross-section view and your current position is displayed in two different views: plan, cross-sections.
A useful command called **'Where am I'** allow to have all design information about your current position along the road: station, H offset, H alignment, V alignment, Design elevation, Elevation, elevation difference from design elevation and from current surface, Cross slope.
A command called 'Survey cross-section' allow to measure cross-section points at any stations.
It is possible to stakeout road design data and use a tridimensional design model(surface) as reference for the elevations.

6.2 Roads manager

Road manager is the control panel of all the data of the road project. They are listed all axes that have been loaded; the road definition can be imported from LandXML format.
It is possible to list road in two different ways:
Select: in this case you can select a road to stakeout.
Edit: when you click a road, the **Delete**, **Edit** and **Property** menus appear, enabling you to delete or edit the road definition, or to edit the properties of the road.
You can switch between **Select** and **Edit** modes via the **Modify** menu at the top right.

TIP
If the road is imported through a LandXML file, you can`t edit the definition of the road, can only view it.

Define a road
When defining a road, you create a rodx file and add elements to complete the road definition.
The **station equations** define station values for an alignment.
The **horizontal alignment** defines a line that runs along the center of the road.
The **vertical alignment** defines the changes in the elevation of the road.
The **cross-section template** defines a cross section of the road at a point across the road to

define how wide it is at different points.
The cross-section template must be defined only for the right side of the section but the definition can also be used for the left side.
Add a template for each change in width. The template may consist of any number of strings.
Add **cross-section template positions** to assign the appropriate template at different stations along the road.
Add **superelevation and widening** to add extra slope and widening on curves in a road design to assist vehicles negotiating the curves.
The **sideslope tempate** defines the shape and the characteristics of the section to be applied along a track; through the composition of simple linear elements it`s also possible to define shapes of complex sections.
The sideslope template must be defined only for the right side of the section but the definition can also be used for the left side.
Add **sideslope template positions** to assign the appropriate template at different stations along the road.

Field	Description
Name	Enter the **Name** to define the road.
Horizontal alignment entry method	Select the **Horizontal alignment entry** method to define the horizontal alignment: **Elements, PI, Coordinates**.
Element entry method	If select **Elements** to define the horizontal alignment, you can select the **Element entry method**: **Length**, **End station**
Elevation rotation axis position	Enter the distance of the point of rotation referring to the central axis.
Start station	Enter the **Start station** to define the road.

Key int the station equations

Use **Station equations** when the horizontal alignment has changed but you wish to remain the original station values.

Field	Description
Ahead	Enter a station value to define the equation.
Back	Enter a station value to define the equation.

TIP
If the Ahead station value is greater than the Backside station value, this equation is an Overlap. If the Ahead station value is less than the Backside station value, this equation is a Gap.

Key in the horizontal alignment

To define the horizontal alignment you can use the:
Elements entry method
Points of intersection (PI) entry method
Coordinates entry method

TIP
To change the entry method for the road, eidt the properties of the road. However, once you have entered two or more elements definition the horizontal or vertical alignment definition, the entry method can`t be changed.

Elements entry method

As you add each element to the alignment, fill out the fields required for the selected element type.

Line elements

To add a line to the alignment, select **Line** in the **Type** menu:

Field	Description
Length	Enter the **Length** to define the line.
Start offset	Enter the perpendicular offset of the starting coordinate of the current element and the ending coordinate of the previous element.
Start north	Enter the **Start north** to define the line. If current element isn`t the first one, the value will be calculated automatically.
Start east	Enter the **Start east** to define the line. If current element isn`t the first one, the value will be calculated automatically.
Azimuth	Enter the **Azimuth** to define the line. If current element isn`t the first one, the value will be calculated automatically.
Use azimuth constraint	If check it, you can enter **Azimuth** instead of the automatically computed value.

Left arc / Right arc elements

To add an arc to the alignment, select **Left arc\Right arc** in the **Type** menu:

Field	Description
Length	Enter the **Length** to define the arc.
Start offset	Enter the perpendicular offset of the starting coordinate of the current element and the ending coordinate of the previous element.
Start north	Enter the **Start north** to define the arc. If current element isn`t the first one, the value will be calculated automatically.
Start east	Enter the **Start east** to define the arc. If current element isn`t the first one, the value will be calculated automatically.
Radius	Enter the **Radius** to define the arc.
Azimuth	Enter the **Azimuth** to define the arc. If current element isn`t the first one, the value will be calculated automatically.
Use azimuth constraint	If check it, you can enter **Azimuth** instead of the automatically computed value.

Left transition\Right transition elements

To add a transition to the alignment, select **Left transition\Right transition** in the **Type** menu:

Field	Description
Length	Enter the **Length** to define the transition.
Start offset	Enter the perpendicular offset of the starting coordinate of the current element and the ending coordinate of the previous element.
Start north	Enter the **Start north** to define the transition. If current element isn`t the first one, the value will be calculated automatically.
Start east	Enter the **Start east** to define the transition. If current

	element isn`t the first one, the value will be calculated automatically.
Start radius	Enter the **Start Radius** of the transition to define the transition. For **Entry Transition**, the **Start Radius** is usually infinite.
End radius	Enter the **End Radius** of the transition to define the transition. For **Exit Transition**, the **End Radius** is usually infinite.
Azimuth	Enter the **Azimuth** to define the arc. If current element isn`t the first one, the value will be calculated automatically.
Use azimuth constraint	If check it, you can enter **Azimuth** instead of the automatically computed value.

Points of intersection (PI) entry method

To add an element to the alignment, select **PI Type**:

PI without curve

PI Without Curve is a point of intersection that doesn`t contain curves.

Field	Description
Name	Enter the **Name** to define the point of intersection.
North	Enter the N**orth** to define the point of intersection.
East	Enter the **East** to define the point of intersection.

TIP

The start point and end point of the alignment must be PI without curve.

PI

PI is a point of intersection that contains curves.

Field	Description
Virtual PI	Define a curve with a corner greater than 180 with the previous PI.
Name	Enter the **Name** to define the point of intersection.
Radius	Enter the **Radius** to define the point of intersection, if the **PI** contains an arc.
North	Enter the N**orth** to define the point of intersection.
East	Enter the **East** to define the point of intersection.
Transition length in	Enter the **Transition Length In** to define the point of intersection, if the PI contains an **Entry Transition**.
Transition length out	Enter the **Transition Length Out** to define the point of intersection, if the PI contains an **Exit Transition**.
Transition start radius in	Enter the **Transition Start Radius In** to define the point of intersection, if the **Entry Transition** is incomplete. If a negative number is entered, it will be used as a parameter to calculate the length of the transition.
Transition end radius out	Enter the **Transition End Radius Out** to define the point of intersection, if the **Exit Transition** is incomplete. If a negative number is entered, it will be used as a parameter to calculate the length of the transition.

TIP
The type of transition supported by the software is clothoid spiral. The clothoid spiral is defined by the length of the spiral and the radius of the adjoining arc. If $A^2 = R*L$, the clothoid spiral is complete, otherwise it is incomplete. If the entry transition is incomplete, you need to enter the start radius. If the exit transition is incomplete, you need to enter the end radius.

Coordinates entry method

As you add each element to the alignment, fill out the fields required for the selected element type.

Line elements

To add a line to the alignment, select **Line** in the **Type** menu:

Field	Description
Start north	Enter the **Start north** to define the line. If current element isn`t the first one, the value will be calculated automatically.
Start east	Enter the **Start east** to define the line. If current element isn`t the first one, the value will be calculated automatically.
End north	Enter the **End north** to define the line. If current element isn`t the first one, the value will be calculated automatically.
End east	Enter the **End east** to define the line. If current element isn`t the first one, the value will be calculated automatically.

Left arc/Right arc elements

To add an arc to the alignment, select **Left arc\Right arc** in the **Type** menu:

Field	Description
Start north	Enter the **Start north** to define the line. If current element isn`t the first one, the value will be calculated automatically.
Start east	Enter the **Start east** to define the line. If current element isn`t the first one, the value will be calculated automatically.
End north	Enter the **End north** to define the line. If current element isn`t the first one, the value will be calculated automatically.
End east	Enter the **End east** to define the line. If current element isn`t the first one, the value will be calculated automatically.
Radius	Enter the **Radius** to define the arc.

Key in the vertical alignment

If you created the road definition by keying in the horizontal alignment, the elevations of those items are used to define the vertical alignment as a series of **Point** elements.
As you add each element to the vertical alignment, fill out the fields required for the selected element type.

Point elements

To add a point to the vertical alignment, select **Point** in the **Type** menu:

Field	Description
Station	Enter the **Station** to define the vertical point of intersection.
Elevation	Enter the **Elevation** to define the vertical point of intersection.

Symmetric parabola

To add a symmetric parabola to the vertical alignment, select **Symmetric Parabola** in the

Type menu:

Field	Description
Station	Enter the **Station** to define the vertical point of intersection.
Elevation	Enter the **Elevation** to define the vertical point of intersection.
Radius	Enter the **Radius** to define the vertical point of intersection.

TIP
The start point and end point of the vertical alignment must be Point.

Key in the cross-section templates

The cross-section template defines the shape and the characteristics of the section to be applied along a track; through the composition of simple linear elements it`s also possible to define models of complex sections that may be subject to superelevations and widenings in curves. Strings typically define the shoulder, edge of the pavement, curb, and similar features that make up a road.

Each element is defined by the **Name**, **Slope**, **Width** and **Vertical offset** referring to the previous element:

Field	Description
Name	Enter the **Name** to define the element of the cross-section.
Slope	Enter the **Slope** to define the element of the cross-section. From the central axis to the side axis, positive values represent uphill and negative values represent downhill.
Width	Enter the **Width** to define the element of the cross-section.
Vertical offset	Enter the **Vertical offset** referring to the previous element of the cross-section.

Key in the cross-section template positions

After adding cross-section templates, you must specify the station at which the Roads software starts to apply each template. A template is applied from that point to the station where the next template is applied.

Field	Description
Station	Enter the **Station** to define the cross-section template position. The station is the start point of the cross-section template will be applied.
Left template	Enter the **Left template** to define the cross-section template position.
Right template	Enter the **Right template** to define the cross-section template position.

TIP
If the cross-section definition changes, you need to reedit the cross-section template positions.

Cross-section template position examples

Add a template for each change in cross-section strings number.

This example explains how positioning of templates and use of widenings can be used to control a road definition:

Key in the superelevations

Superelevation values are applied at the start station, and values are then interpolated from that point to the station where the next superelevation values are applied.
Each element of the cross-section can apply a superelevation value.
The software supports the following superelevation interpolated types.

Linear

Cubic parabola

Field	Description
Station	The start station where the superelevation value is applied.
Primitive slope(%)	The original slope value of the current element of the cross-section.
Superelevation(%)	Enter the **Superelevation** to the selected element.

Key in the widenings

Widening values are applied at the start station, and values are then interpolated from that point to the station where the next widening values are applied.
Each element of the cross-section can apply a widening value.
The software supports the following widening interpolated types:

Linear

Cubic parabola

Quartic parabola

Field	Description
Station	The start station where the widening value is applied.
Primitive width	The original width value of the current element of the cross-section.
Widening	Enter the **Widening** to the selected element.

Key in the sideslope templates

The sideslope template define the shape and the characteristics of the sideslope to be applied along a track; through the composition of simple linear elements it`s also possible to define models of complex sideslope.
Each element is defined by the **Name**, **Slope**, **Width**:

Field	Description
Name	Enter the **Name** to define the element of the sideslope.
Slope	Enter the **Slope** to define the element of the sideslope. The shape of the sideslope is relative to the left/right side axis point at a certain station. From the side axis to the direction away from the center axis, positive values represent uphill and negative values represent downhill.
Width	Enter the **Width** to define the element of the cross-section.

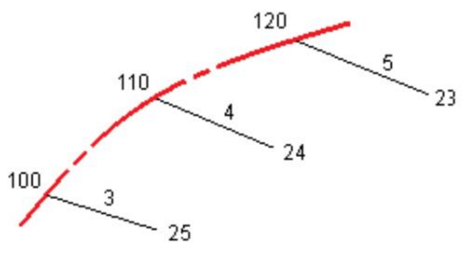
Key in the sideslope template positions

After adding sideslope templates, you can specify the station at which the Roads software starts to apply each template. A template is applied within a range specified by the start station and end station.
The software supports the following sideslope transition types:

No gradient: The same sideslope template is used for this range.
Gradient: A start template is applied at the start station and an end template is applied at the end station. The values defining each element are then interpolated linearly from the start station to the end station. The start and end template must have the same number of elements.

Field	Description
Start station	The station that the sideslope template begin to be applied.
End station	The station that the sideslope template stop to be applied.
Transition method	The transition type from the start sideslope template to the end sideslope template.
Start template	Define a sideslope shape at the starting of the range.
End template	Define a sideslooe shape at the ending of the range.

Import road definition from LandXML format
LandXML road file can contain one or more alignments with associated road definition information.
Select the LandXML file to import. All axes will be loaded and visualized in the list.
The software can obtain the following road components from a LandXML file:
Station equations: Define station values for an alignment.
Horizontal alignment: Define a line that runs along the center of the road.
Vertical alignment: Define the changes in the elevation of the road.
Cross-section: Define how wide it is at different points across the road. The cross-section may consist of any number of strings.
String interpolation
The cross-sections are computed by determining where the cross-section line, formed at right angles to the alignment cuts the strings associated with the alignment. For interpolated stations the offset and elevation values for the position on an associated string is interpolated from the offset and elevation values of the previous and next positions on that string. This ensures the integrity of the design, especially on tight curves.
See the following example, where the cross section at station 100 has a string offset from the alignment by 3 and an elevation of 25. The next cross section at station 120 has a string offset by 5 and an elevation of 23. The position on the string for the interpolated station 110 is interpolated as shown to give an offset of 4 and an elevation of 24.



TIP
No interpolation occurs between cross-sections with an unequal number of strings.

6.3 Stakeout road

Stakeout of a road axis is quite similar to stakeout an element by station and offset. According to the entered station it's interpolated and visualized the corresponding cross-section. On the calculated section specify the distance from the center line; it's possible to select the vertex also from graphic view.

Field	Description
Real time station	Automatically calculate the stakeout station according to the current position.
Station	The station of will be stakeouted.
Station interval	
Mode	The mode of offset value, right angle offset or skew offset.
Cross-section surface	Select the vertex from graphic view.
Offset	Define a point at a right angle to the alignment. It's possible to add an additional offset for construction.
Elevation	The elevation of the target; It's possible to add an additional vertical offset for subgrade.
Azimuth	Skew direction, a delta from the alignment tangent clockwise.
Length	The offset along the skew.

The stakeout panel contains the information to get the target point.

The last part of the panel can show the following information:

Dist.: The distance from current position to the target.

Stat.: The station of the current position.

Forward/Backward: Navigation information from current position to the target.

Left/Right: Navigation information from current position to the target.

H.Offset: The distance from the current position to the alignment.

Delta station: The difference between the station of current position and the station of the target.

Cur/Fill: Vertical cut/fill to the design.

Stakeout relative to a DTM

You can display the cut/fill to a digital terrain model (DTM) during stakeout, where the horizontal navigation is relative to the road but the displayed cut/fill delta value is from your current position to a selected DTM.

6.4 Stakeout side-slope

The procedure allows to perform the calculation and the stakeout of the point of intersection of the project side-slope with the existing terrain; the position is calculated on the basis of a slope of project and referring to a station and to a distance(offset) on the outermost of the cross-section.

Field	Description
Match the template according to the station	Automatically select a sideslope template based on the current position and the sideslope template positions.
Station	The station of the current position.
Template	The sideslope template of automatic or manual selection.
Target	The stakeout target, feature points of the sideslope or the slopes.

The side panel contains the information to get the point of intersection; The lastest information reports the current value of the slope and the direction to take, on the perpendicular to the

reference element, to achieve the value of project slope.
The last part of the panel can show the following information:
Stat.: The station of the current position.
H Offset: The distance from the current position to the alignment.
Inward/Outward: Away from or near the centerline.
Down/Up: Vertical cut/fill to the design.
Cur/Fill: Perpendicular cut/fill to the design.

6.5 Where am I

This function is able to provide much information concerning the current position referring to the selected road.
Basing on the position they are visualized the following information:

Field	Description
Station	Station in which you are located.
H Offset	Distance from the center line of current road.
H alignment	Element of the planimetric track.
V alignment	Element of the altimetry track.
Design elev.	Design elevation in which you are located.
Elev.	Elevation in which you are located.
Cut/Fill	Elevation difference.
Cross slope	Cross slope in which you are located.

6.6 Survey cross-section

The procedure allows to perform the measurement along a cross-section. During the cross-section measurement, a red auxiliary line will be created. The cross-section data measured can be used to calculate the volume.

Field	Description
current	Get the station of current position.
Station	The station of the current position.

The cross-section survey panel contains the information to measure cross-section points.
The last part of the panel can show the following information:
Stat.: The station of the current position.
CL offset: The distance from the current position to the alignment.
Delete station: The difference between the station of current position and the station of the target.
Cur/Fill: Vertical cut/fill to the design.

6.7 Stakeout report

Use the **Report export** function in the software to generate a report from survey data. Use the report to transfer data from the field to your client or the office for further processing with office software.
A table present the list of all the stakeout points with differences, in distances and elevations, between the design coordinate and the stakeout coordinate.
The file format is:

Field	Description
Point name	The name of the measured point.
Target N	The northing coordinate of the target.

Target E	The easting coordinate of the target.
Target elevation	The elevation of the target.
Target station	The station of the target.
Target H Offset	The H Offset the target.
Measured N	The northing coordinate of the measured point.
Measured E	The easting coordinate of the measured point.
Measured elevation	The elevation of the measured point.
Measured station	The station of the measured point.
Measured H Offset	The H Offset of the measured point.
Delta station	The difference between the design station and the stakeout station.
Delta H Offset	The difference between the design H Offset and the stakeout H Offset.
Delta elevation	The difference between the design elevation and the stakeout elevation.
Cross-section offset	Horizontal offset relative to the cross-section.
Time	The time of the measuring point.

6.8 Display the available stations

Some key stations defined by the horizontal alignment will display on the screen. The station abbreviations used in the Roads software is:

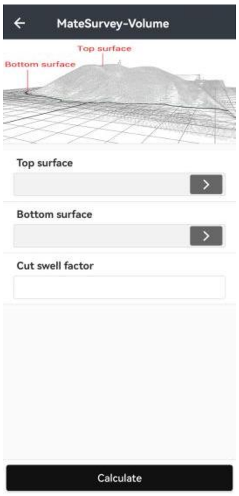
Abbreviation	Meaning
RS	Road start
RE	Road end
CC	Curve to transition
LT	Line to transition
CL	Curve to line
TL	Transition to line
LC	Line to curve
TC	Transition to curve

7 Tools

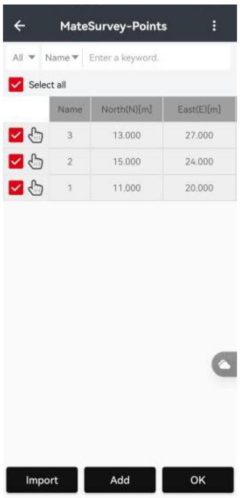
7.1 Volumes

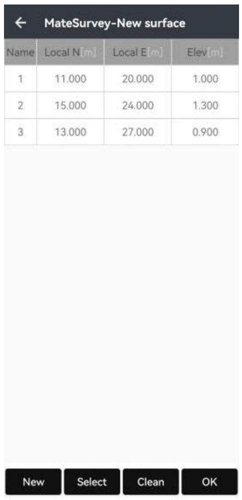
Surface with Height:

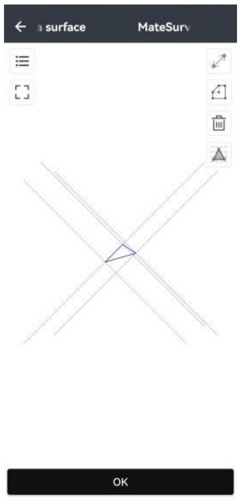
Top/Bottom Surface: Import above surface file. Click import icon to enter **Surface File** interface.



Users can choose surface file or create a new surface file by selecting points. Click **New** to create a new surface file, users can add a new point or select point in **Points**, then click **OK** to preview the surface.







In this interface users can modify constraint line, boundary, and points of surface.

: Tap to view coordinates of points. Users can also input new points, select more points from points library, or delete points.

: Tap to view full screen.

: Tap to determine the constraint line. Select two constraint points and create a constraint line. Then tap the triangulation networks generating icon. The line created by the constraint points won't be changed after calculating.

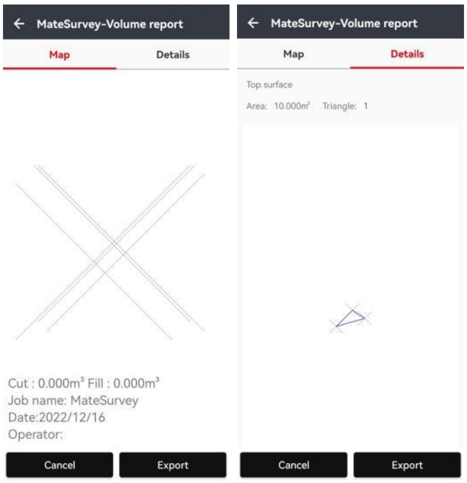
: Tap to modify the boundary. Choose two points to create a new line for determining a new boundary, and then delete the wrong part of the boundary.

: Tap to delete a useless point or wrong part of the boundary. Tap the icon, select a target point or line, and tap **[OK]** to confirm the deletion.

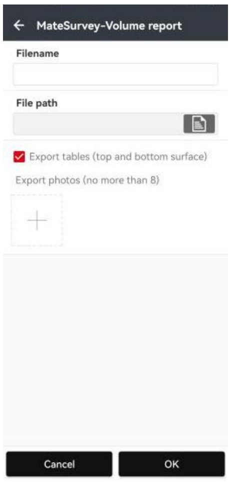
: Tap to generate new triangulation networks.

Cut swell factor: Input cut swell factor, range from 0 to 1.

Finally, click **Calculate** to get result. From the result interface users can select Map or Detail. In the Map interface users can get cut or fill value, in the Detail interface users can know area and triangle of top surface and bottom surface.

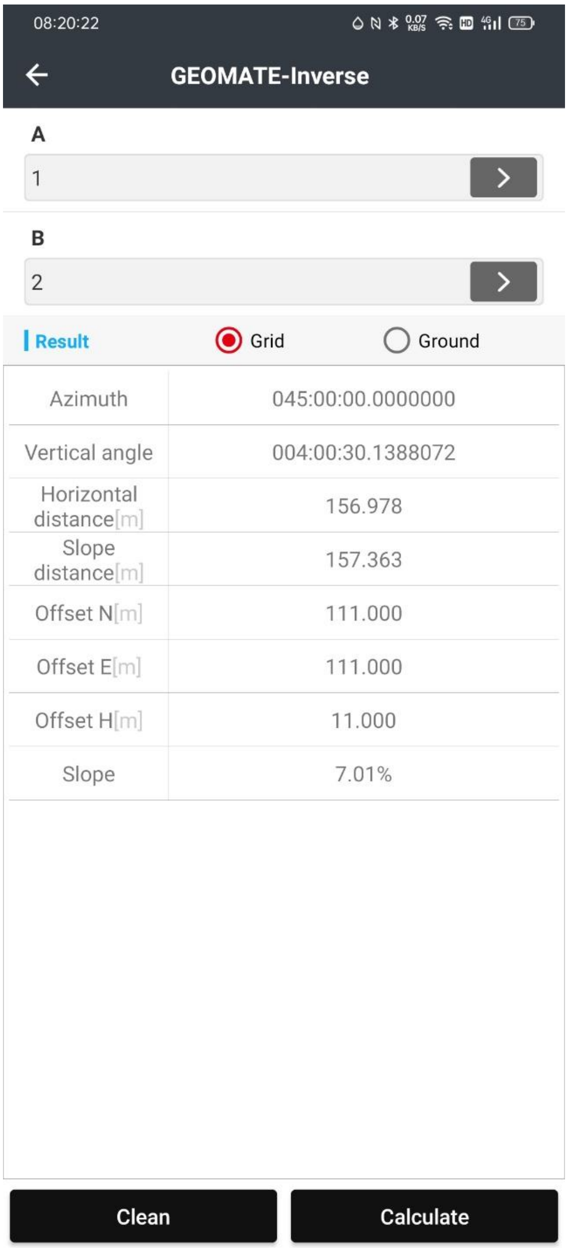


Click **Export** users can export the result with some photos (no more than 8).



7.2 Inverse

Select starting point A and ending point B from point manager, click **Calculate** to calculate. The results calculated according to grid or ground surface will be shown in the table. The results contain: azimuth, vertical angle, horizontal distance, slope distance, offset N, offset E, offset H and slope.



7.3 Area

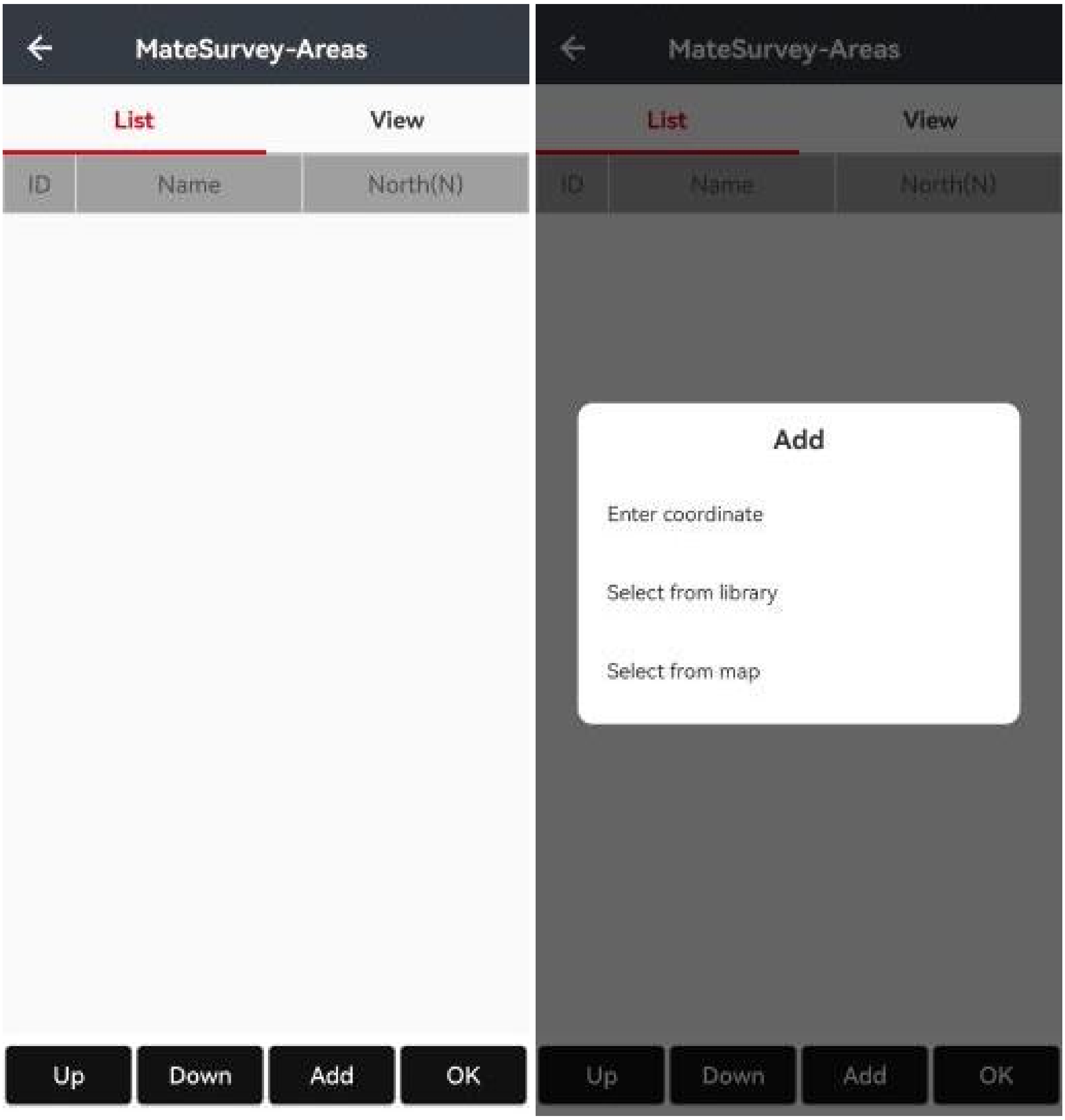
This function is to calculate the area, perimeter of figure, the coordinates that participates resolve are chosen from point management by library chosen. The unit of perimeter is metric, and the unit of area supports square meters.

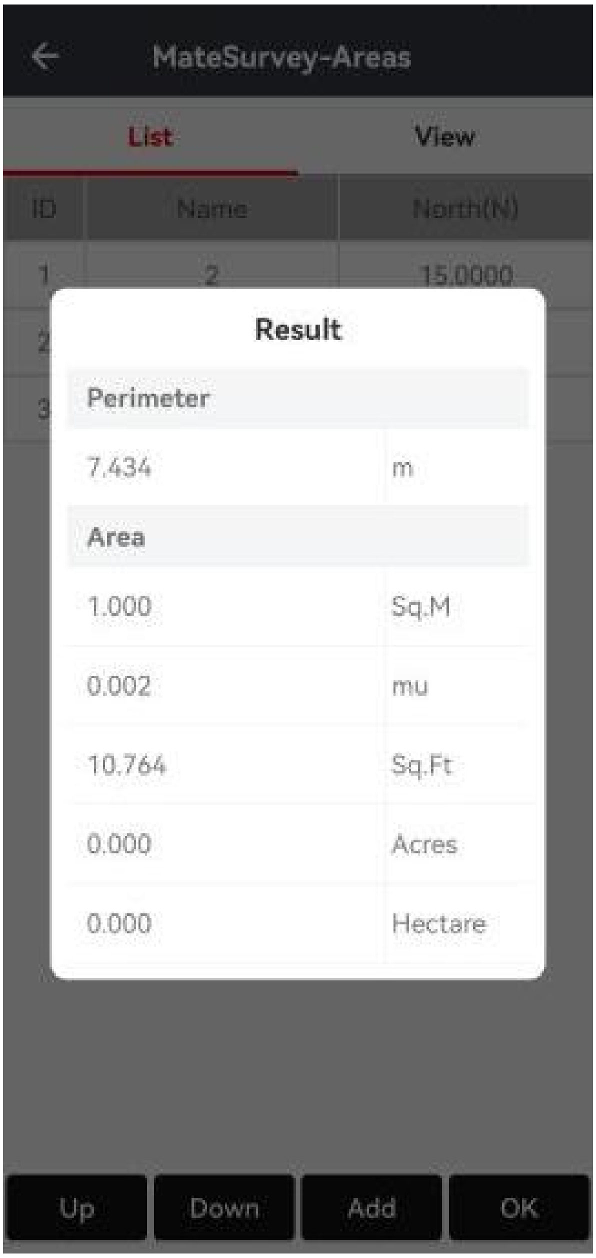
Add: Enter coordinate, select from library or map to add points to the list.

Up/Down: Make selected points move up or down.

Right slide: Right slide to delete point or check the details of the point.

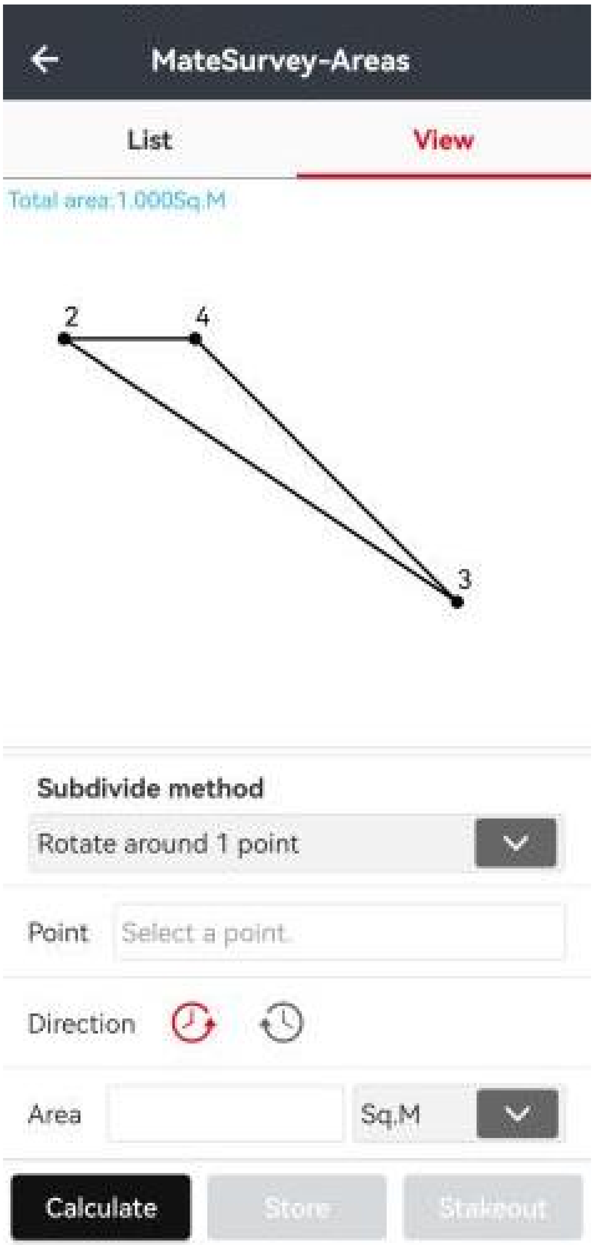
OK: Calculate the perimeter and area of the figure which is composed of points in sequence.


MateSurvey-Areas
List
View
ID
Name
North(N)
Up
Down
Add
OK
MateSurvey-Areas
List
View
ID
Name
North(N)
Add
Enter coordinate
Select from library
Select from map
Up
Down
Add
OK

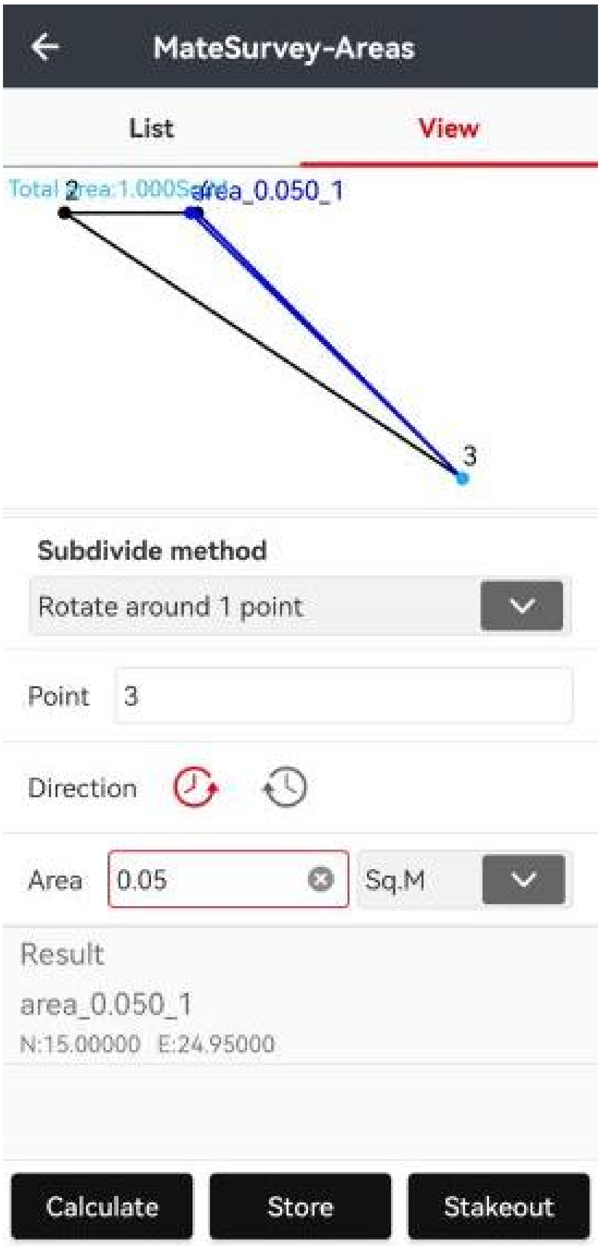


Area Division: Cut the selected area according to the value inputted.

Choose the Calculation type, input the area, should less than the whole selected area.



Click Calculate, after that, you can store or stakeout calculated point.

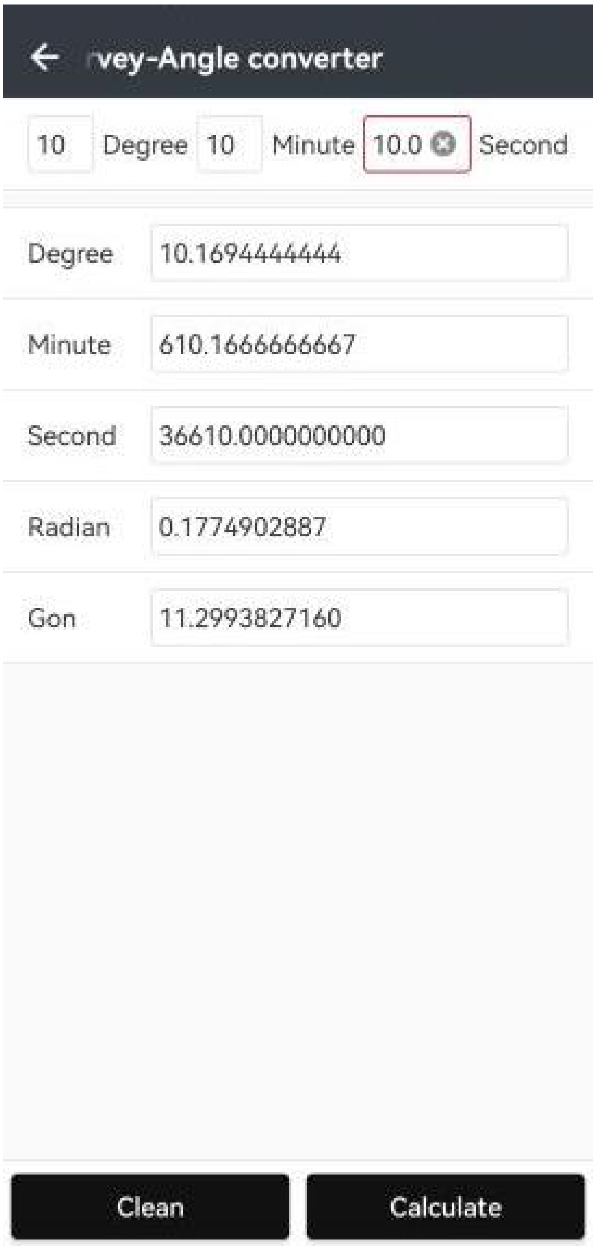


7.4 Angle conversion

Angle conversion can convert degrees, minutes, seconds and radians among these 3 types of conversion.

Enter a value in degrees, minutes and seconds edit box, click on the **Calculate** button to calculate the value of the corresponding degrees and radians.

Similarly, it can convert radians to degrees and degrees, minutes and seconds, or converts degrees to radians and the value of every minute.



7.5 Parameter calculation

Calculation Type: Include 7 Parameters, 7 Parameters(strict) and 3 Parameters.

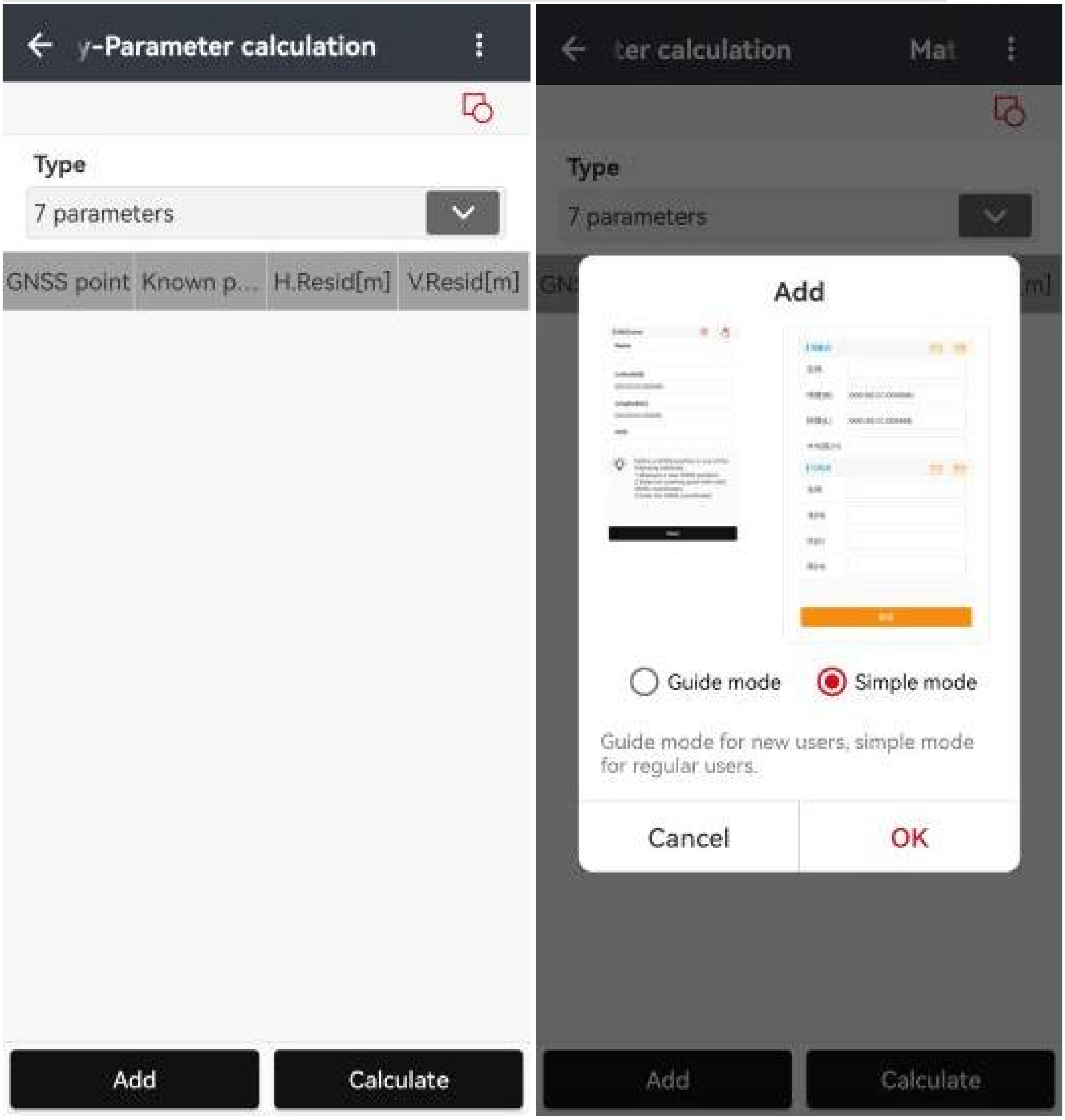
7 Parameters/(strict): The application scope of 7 Parameters/(strict) is relatively large, generally larger than 50 km. Users need to know at least three/four pairs of known point values in local coordinate system and their corresponding WGS-84 coordinates. Only when we get the 7 parameters transmitting from WGS coordinate system to local coordinate system, can we start the parameter calculation.

3 parameters: At least one known point pair is requested which is usually used in small scales. The accuracy is up to the operating range, decreasing with the increase of operating distance.

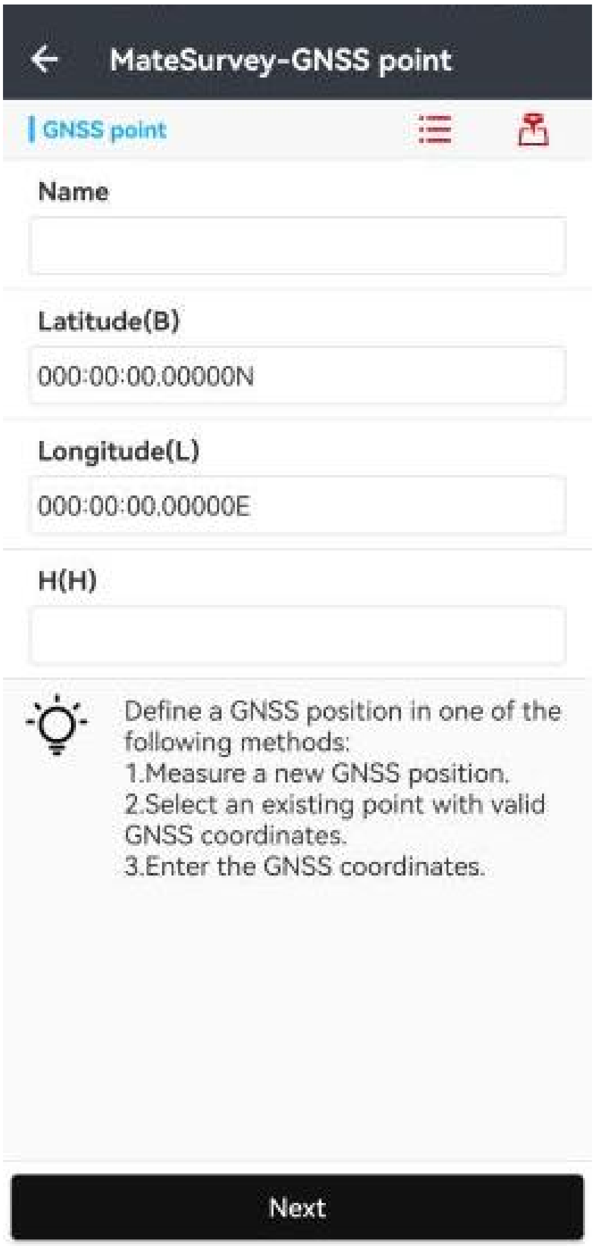
Mode: We can choose **Guide mode** or **Simple mode** to add point pairs based on different situations.

Select Point Pair: Click **Add** to add point pairs and input pairs of GNSS points and known points to calculate parameters. Add WGS-84 coordinates at **GNSS Point** and add plane coordinates at **Known Point**.

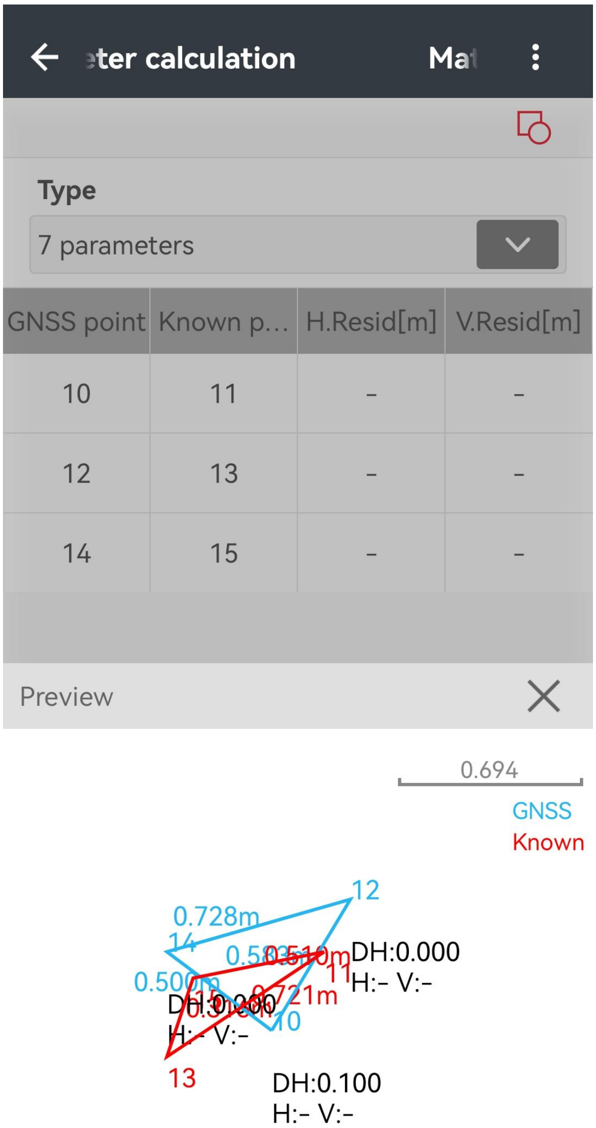
GNSS Point: Select from library, survey or enter manually to add GNSS points.
Known Point: Select from library, map or just enter manually to add known points.
Note: Select corresponding point pairs and add to the interface of parameter calculation.



Calculate: Click to calculate. The results will be popped up automatically. Then click **OK** to apply the parameters to the current project.

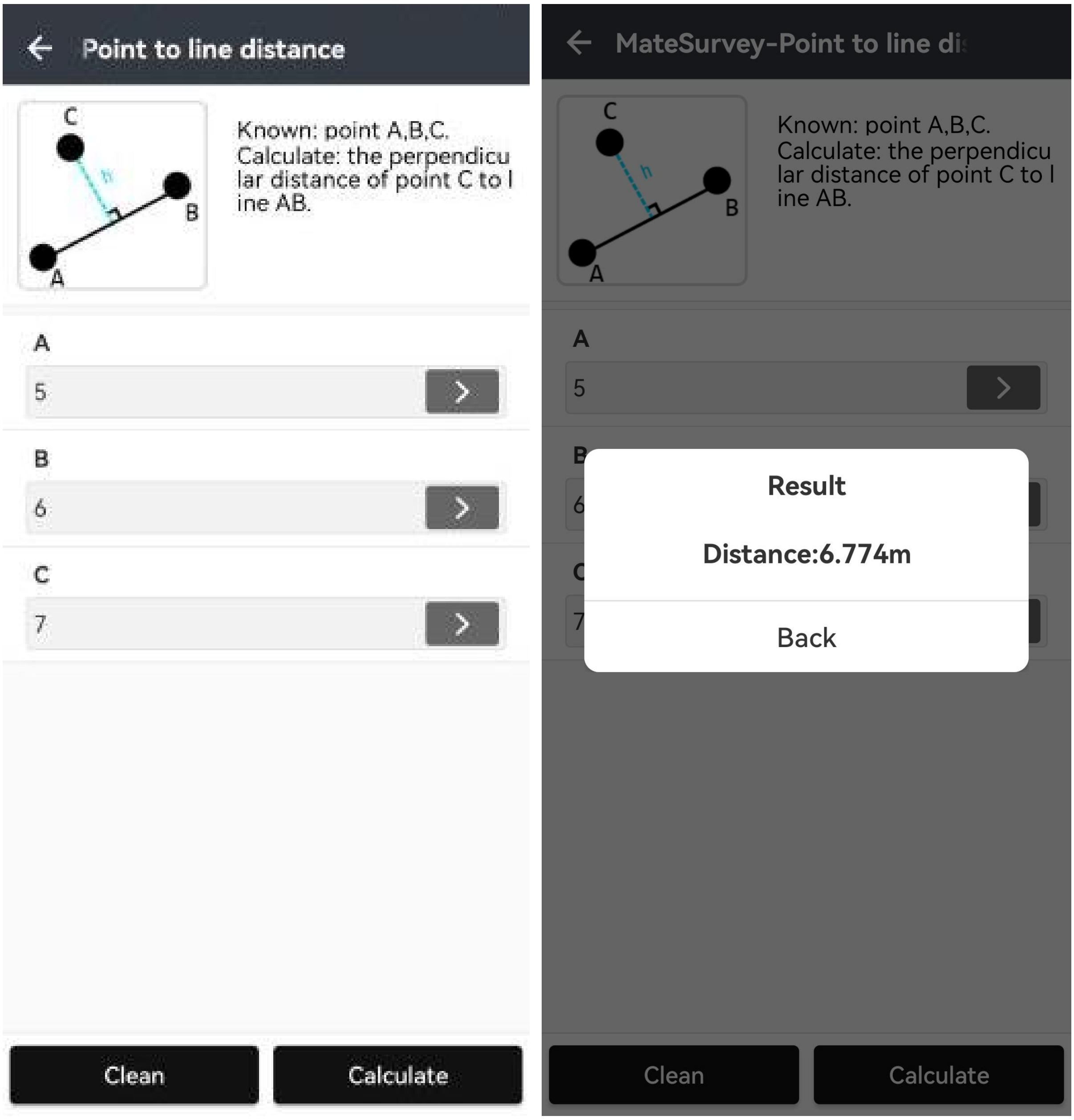


Datum trans: Back to the main menu, click **CRS** to view Datum trans interface and the parameters can be viewed. Click more, you can choose to lock the parameters and the default password is 123456, which can also be changed. And we can also click unlock to edit parameters.



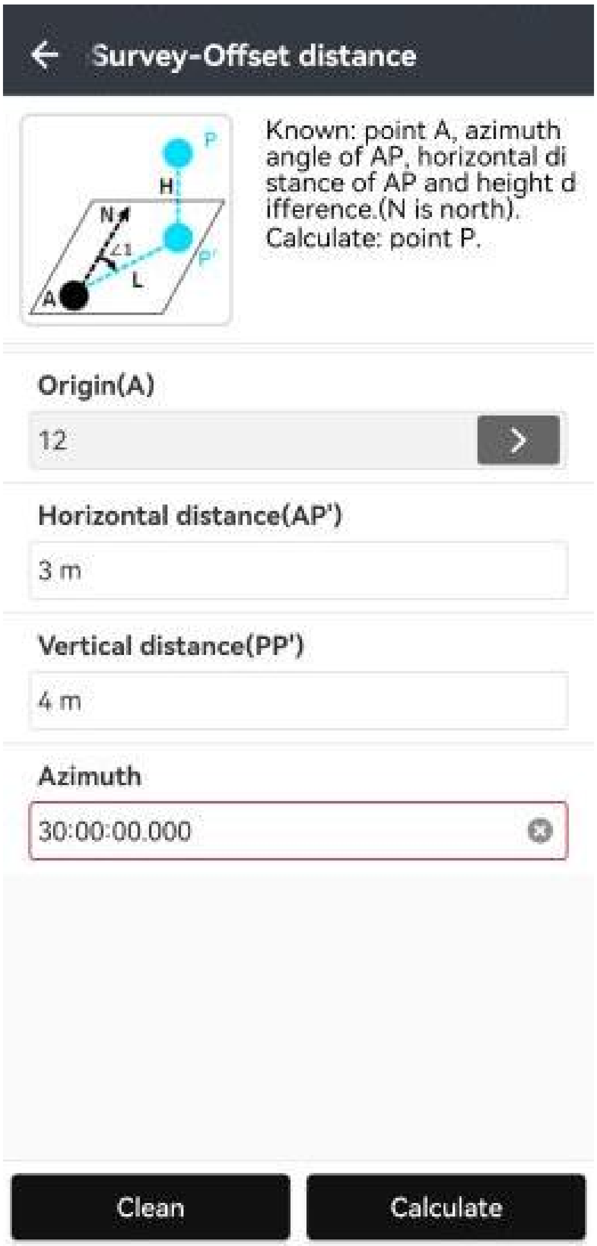
7.6 Point to line dist

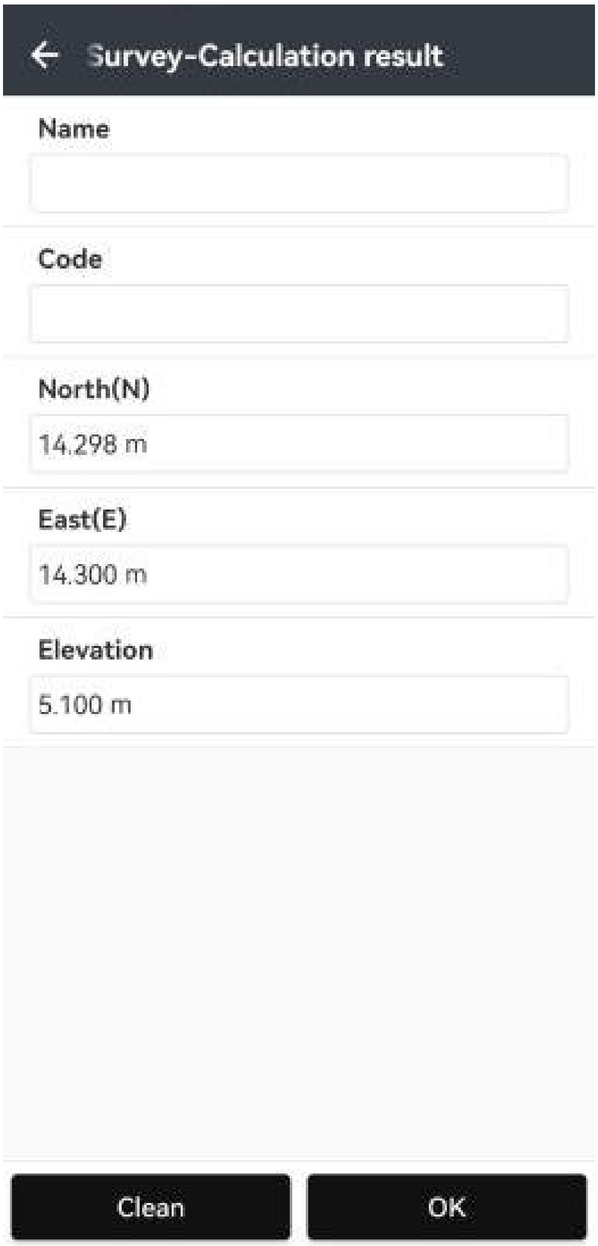
Select points A, B, C from point management and click **OK** to calculate. The result is displayed in a pop-up box, as follows: click **Clean** to clear current data.



7.7 Offset distance

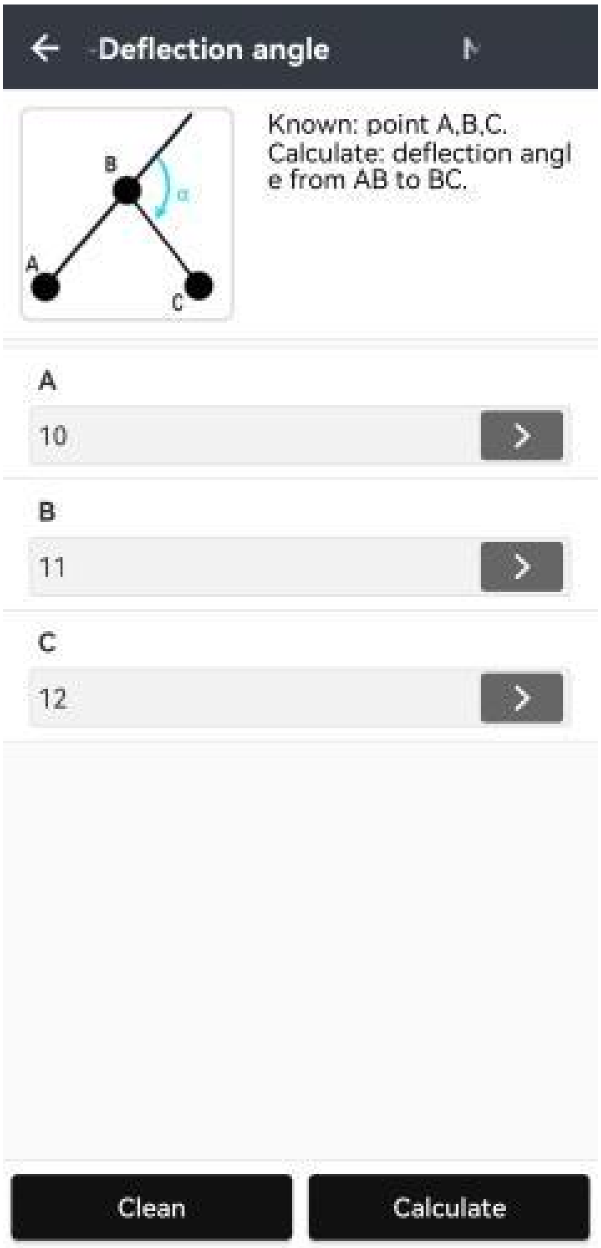
Origin (A): Select form **Points**.
Horizontal distance (AP'): Input the horizontal distance.
Vertical distance (PP'): Input the vertical distance.
Azimuth Angle: Input the azimuth angle.
Calculate: Click **Calculate** to display a calculation result interface, enter the point name, and click **OK** to save the calculated point.





7.8 Deflection

Deflection: Click **Deflection** to calculate deflection angle. Select Point A, B, C, and click **OK**, the angle will be displayed in pop-up interface.



7.9 Rotation

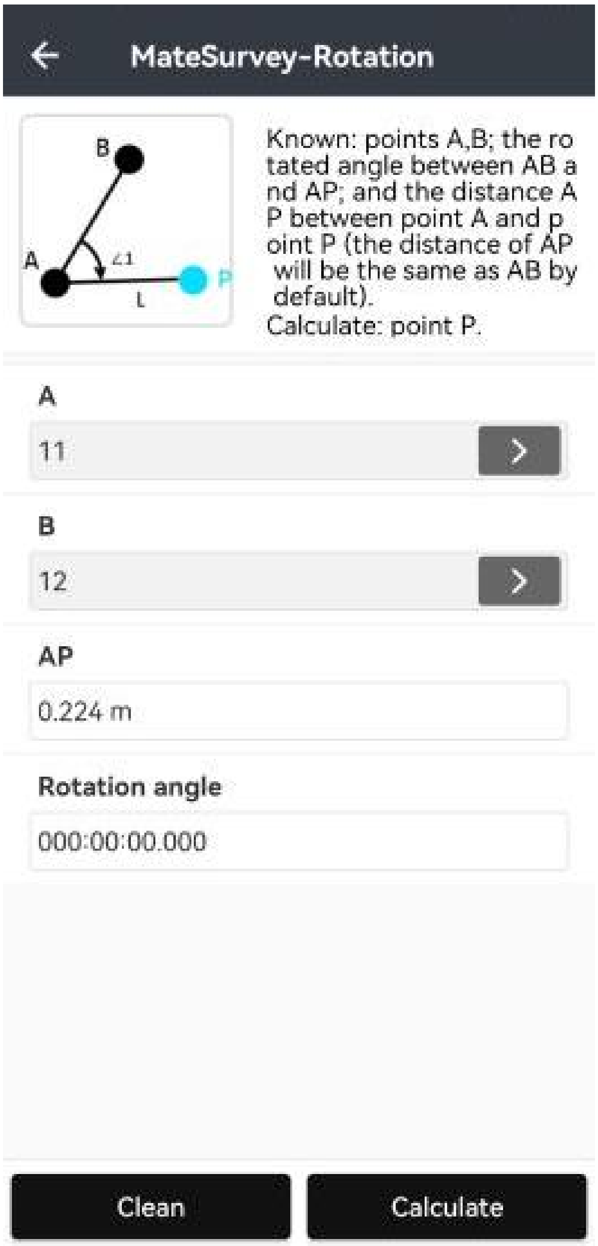
Rotation: Point P is on the line AB which rotates a certain angle. After selecting AB points, the system will calculate the distance between point A and point B as default and this distance as initial value for AP.

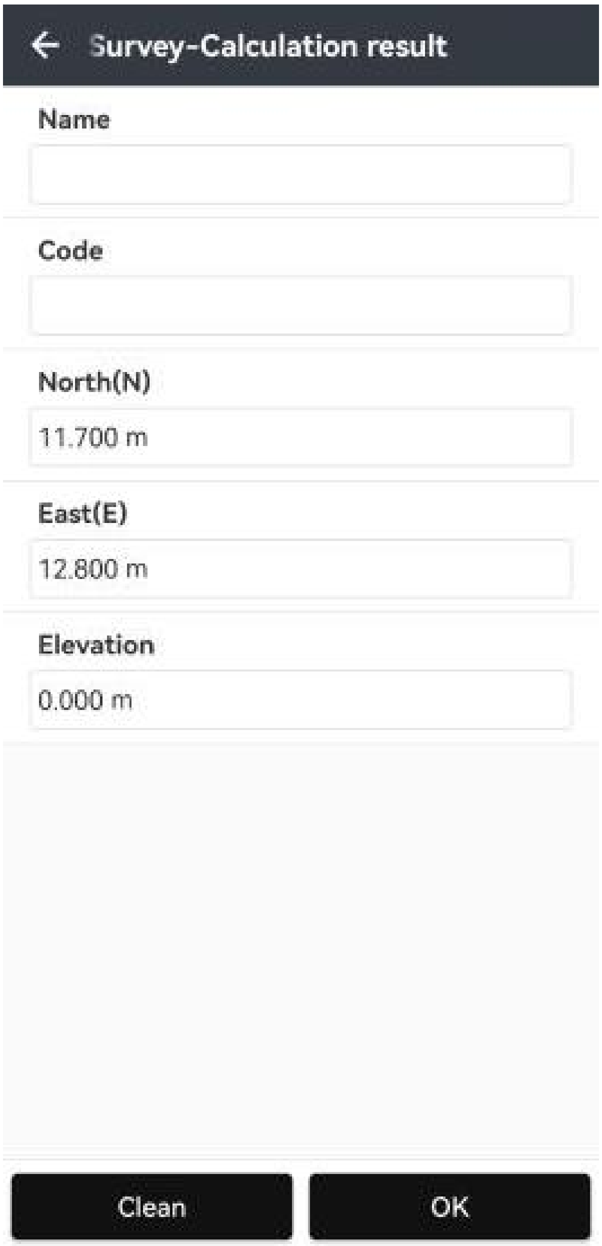
A/B: Select the coordinate of A, B from **Points**.

AP: Distance from point A to point P.

Rotation Angle: The rotated angle between AB and AP.

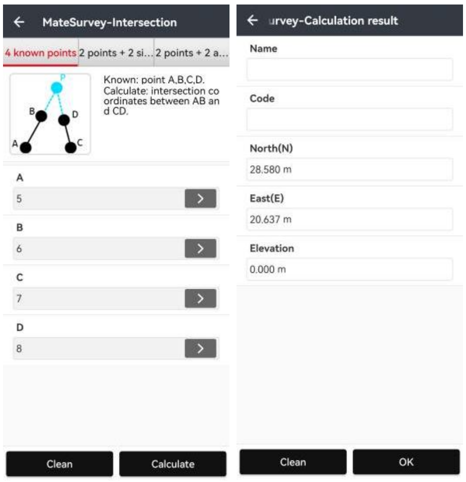
Calculation Result: Click **Calculate** to get the result. Input name and then click **OK** to save this calculated point.



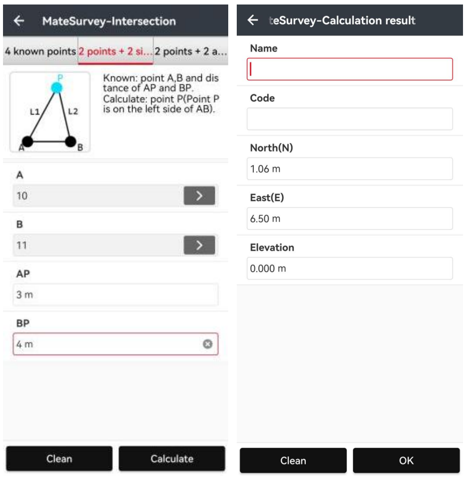


7.10 Intersection

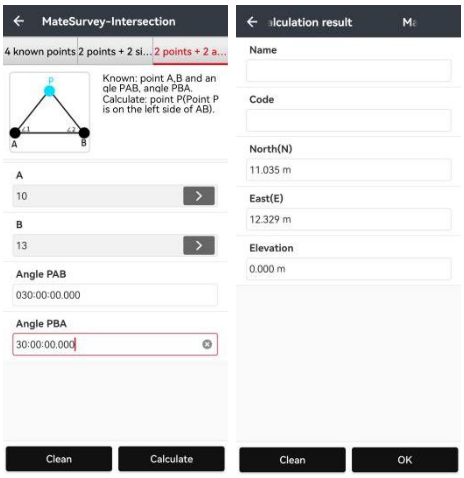
Known Points: Select points from point management and click **Calculate** to calculate the intersection P of line AB and line CD.



Points + 2 Sides: Select points A and B from point management. Enter the length of line AP and line BP. Click **Calculate** to calculate. Input a name and click **OK** to save.

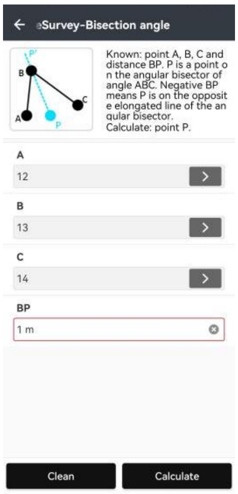


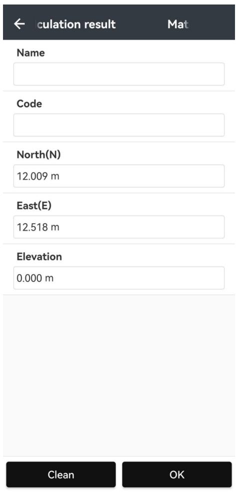
Points + 2 Angles: Calculate intersection P with known points A and B and the inner angle of PAB. Click **Calculate** to calculate. Input a name and click **OK** to save.



7.11 Bisection angle

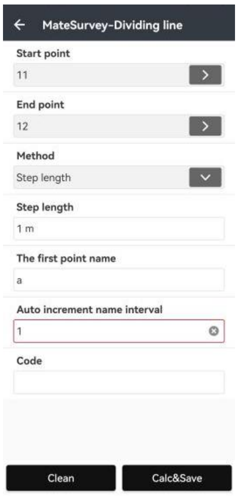
Bisection Angle: Given line BA and BC comes to an angle ABC, P is one point on the angle bisection line, according to the coordinates of Points A, B, C, and the plane distance from Point P to Point B, we can have the coordinate of Point P. If the distance value is negative, it means Point P is on the oppositely extension line of the angle bisection line. Click **Calculate**, the results will show out, input the point name, and click **OK** to save the calculated point.





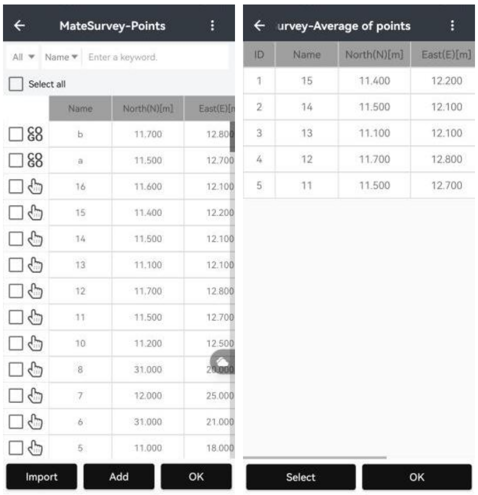
7.12 Dividing line

Dividing Line: Select start point and end point from **Points**, select **Method**, Input step length, first point name and name interval, then click **Calc&Save**; it will remind users a successful division. Click **Points** manager to review points.

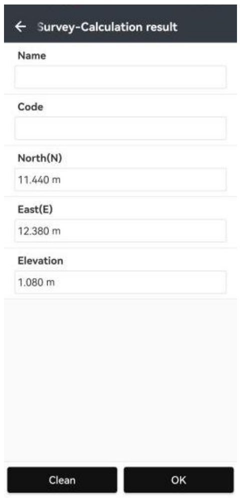


7.13 Average of points

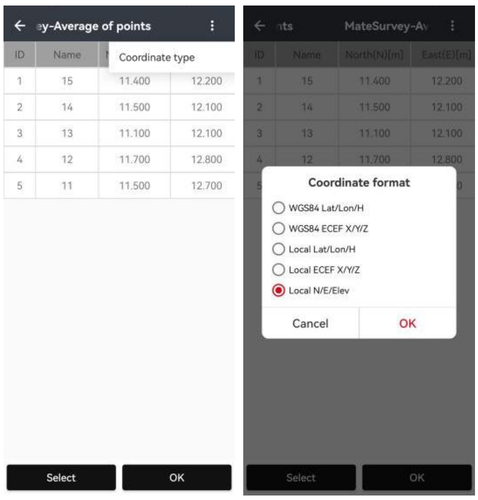
Select: Select points to calculate.



OK: Report the average value of selected points in calculation result interface.

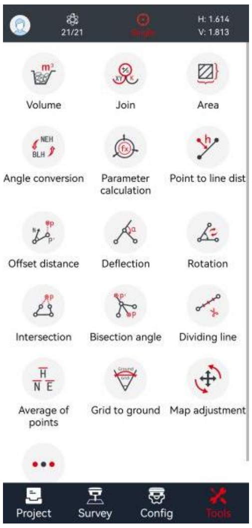


Coordinate Type: Users can set coordinate types of points.



7.14 Grid to ground

While surveying in the same area, users can get grid coordinates or ground coordinates with a GPS receiver or a total station, but it is unable to deal with different kinds of coordinates when post-process data. **Grid to Ground** function is used for calculating the combined factor and transform grid coordinates into ground coordinates, so that users can work with both total station and RTK receiver in the same project.



Tap **Grid to ground** in **Tools** interface. There are three methods to select grid coordinate: from Points, map selection and calculate directly. There needs two points for calculation, the first point coordinates are default as current base station coordinates. Grid scale factor, height scale and combined factor will be calculated after selecting second point coordinates. (Combined factor can also be inputted.)

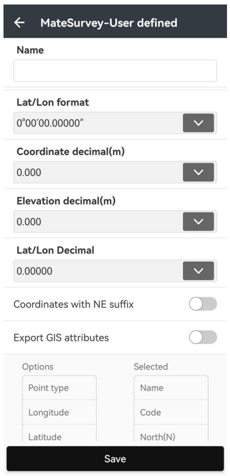
3 ways to choose points:

(1) **Map Selection**: Select a point in base map or measured point.

(2) **Survey**: Click to get the current position.

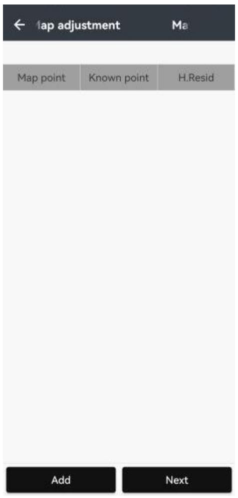
(3) **Points**: Click to choose points in points list.

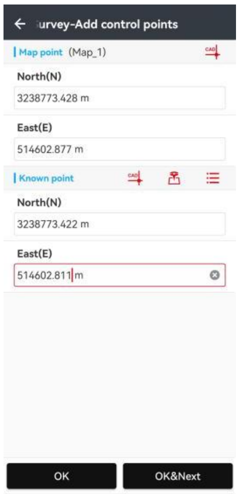
Click **Accept**, and then users will see transformed ground coordinates in point detail. There is no need to apply combined factor when it's 1, because default combined factor is 1 and users can view the ground coordinates in point detail directly. These ground coordinates can also be exported as TXT, DAT, or CSV format with customized content.



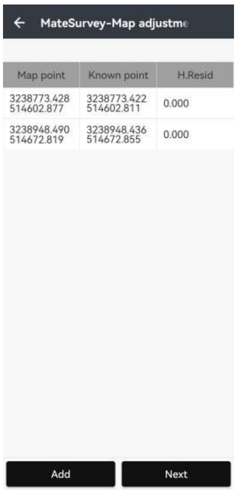
7.15 Map Adjustment

Add: Click add to add Map point and Known point (point pair).
Map point: Choose point on base map.
Known point: Choose point on base map, points, or survey directly.
Click **OK&Next** to add next point pair; click **OK** to finish adding points.





After adding all point pairs, click **OK** and there will show **H.Resid**. The smaller the residual is, the better the accuracy is.



Click **Next** to calculate the translation, the rotation, and the scale. It shows how the base map moved. Finally click **OK** to apply

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