RTK Multifunctional Handbook Software Instruction Manuals

September 2023

Introduction

Introduction of the Manual

This manual provides a detailed description of how to use the handbook software and guides the user on how to use the software to configure the receiver, survey mapping, road surveying, power surveying, and other tasks.

Experience Requirements

In order for you to use the GoodSurvey software, it is recommended that you have some knowledge of surveying and that you read this manual carefully. If you have any questions about using the software, please contact us.

Exemption from Liability

Please be sure to read the instruction manual carefully in order to use the product properly. GoodSurvey is not responsible for any damages caused by your failure to follow the instruction manual or your failure to properly understand the requirements of the instruction manual resulting in the mishandling of the product.

However, we are committed to continuously improving the function and performance of the product, improving the quality of service, and reserve the right to change, optimize and improve the content of the instruction manual, and inform the updated content in the form of upgrading the release, please pay attention to the GoodSurvey official website (http://www.goodsurvey.cn/) the latest stakeout of the information, the instruction manual is subject to change Please note that this manual is subject to change without prior notice;

Although we have double-checked the consistency of the contents of the printed materials and the hardware and software, however, we do not exclude the possibility that there is still a deviation, the pictures in the instruction manual are for reference only, if there is any inconsistency with the product in kind, please take the product in kind as the standard, and the final right of interpretation belongs to Guangxi GoodSurvey Navigation Terminal Co.

Related Information

You can find the instruction manual by:

Through the GoodSurvey website, you can find the download at [Download Center] - [Instruction Manual].

Your Suggestions

If you have any comments or suggestions about this manual or the software, please contact us, we will be very grateful for your contribution to the improvement of GoodSurvey product quality, and at the same time, our company will return your efforts accordingly.

Technologies and Services

Thank you for purchasing and using GoodSurvey products, if you still have any questions after studying the manual, you can contact us by phone or e-mail, and we will be sure to answer your questions at the earliest time and can carry out related useful discussions.

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Chapter I. Introduction to Software

1.1 Software Introduction

GoodSurvey is a multifunctional GNSS measurement software for the Android platform launched by Guangxi GoodSurvey Navigation Terminal Co., Ltd, which is used with GoodSurvey GNSS RTK receiver. According to the engineering experience accumulated in the past thirty years, while combining the functional characteristics of mainstream surveying and mapping data collection software at home and abroad, it integrates the functions of surveying, mapping, road design and release, electric power survey and release, point release, line release, point correction, parameter calculation and so on. The software has humanized operation, a good graphical interactive interface, and rich functions organically integrated into one, making your field surveying work easier.

Measuring and Plotting Functions

The traditional handheld electronic tablet mapping system is difficult to widely use in practical work because of the complex mapping operation and the one-time mapping mode in the field, which takes up more time for field operation; while the coded mapping is difficult to avoid the trouble of remeasuring, omitting to measure or even needing to check the field for many times; and at the same time, it is difficult to improve its efficiency by adopting the method of hand-drawn sketches and so on.

The software adopts the thinking mode of "electronic sketch", the so-called electronic sketch, is my company's R&D team after nearly three decades of dedicated research in this area, innovative proposed and realized. The so-called electronic sketch is innovatively proposed and realized by our R&D team after nearly thirty years of research in this field, i.e., the use of electronic tablet to draw sketches instead of traditional paper sketches, and the biggest advantage lies in the accuracy of the relative relationship between the measured points of electronic sketches, and the use of hand-drawn lines and multi-segmented lines combined with the advantages of the Android system, which can be used to draw sketches on the electronic tablet quickly,

and organically combine the traditional outdoor data collection and indoor mapping work, avoiding the shortcomings faced by the traditional mapping and can greatly increase the efficiency of the operation.

Electronic sketches can record a large amount of information and plot quickly, either using a stylus or finger to draw hand-drawn lines connecting survey points or using object capture point locations to draw multi-segmented lines, which can be left for retouching to be processed in-house. Finger touchscreen plotting can also be fast based on the magnifying glass function and object capture on the diagram.

The software provides a selection of most of the Southern CASS drawing symbols (reference blocks) and polylines, which can be quickly selected for drawing by sorting through the recent symbol library and frequency of use. The symbol library provides a symbol preview for quick identification and selection. The polyline drawn through the symbol library can show the line type, such as cans, slopes, etc., and long-pressing the end button can immediately change the orientation of the line type; inserting reference blocks, such as paddy field symbols, street lamp symbols, etc., makes the graphics more intuitive, with good compatibility and easy to use.

Graphic files can be exported to CAD (dwg, dxf) format, field survey point numbers and elevation points can be exported at the same time, and opened directly by Southern CASS, feature symbols (reference blocks), feature attributes, layers, line types, etc. are fully compatible with CASS.

The "line measurement" function can automatically connect the line when collecting points, and the line measurement function and the manual connection function can be carried out interactively, and the drawing process is smooth with a two-touch screen for panning and zooming and a single-touch screen for drawing. When measuring a line, you can switch to other drawing commands, and when other drawing operations are completed, you can continue to measure the line.

The software provides user-friendly drawing operations such as layer management, drawing color settings, object capture settings, magnifying glass, display settings, and so on. Provide rich information entry, such as graphic insertion of text, photos, videos, etc.

Compared with coded mapping, using the survey mapping function, the points

are directly connected to form a map, rich topographic feature information is collected, there will be no missed measurements, and the whole process of surveying becomes easy, greatly reducing the workload of internal work.

Support connecting the total station to measure the fragmented points, real-time total station coordinates spread point plotting, and improve work efficiency.

Road Functions

GoodSurvey is developed for road survey and sampling, with powerful functions to support complex road sampling. The software provides road line design functions, flat section line design, cross-section line design, and longitudinal section line design.

Characteristics of road surveying:

1. Support the import of flat section, longitudinal section, cross-section, slope data for road sampling, and visualization of cross-section collection.

2. Input mileage real-time calculation of line sampling points, you can input any mileage to calculate the stakeout point, input offset sampling slope line, and the current point of real-time mileage projection display.

3. Provide intuitive and fast sampling prompts, handbook electronic compass display, into the sampling fine-tuning area of the automatic scaling and scale display, road sampling flat section and cross-section view switching, real-time display of any position of the road surface filling, and digging value.

4. Level section line design supports commonly used intersection method and line element method, which can be any combination of road line type, you can preview the design drawings and mileage coordinate calculation check.

5. Cross-section line design can be set up with more than one variable slope point, design left-right symmetrical or asymmetrical type.

6. Support broken chain, super high, widening design.

Electricity Measurements

The power measurement function provides power survey, tower placement, and tower base section measurement. Measurement data is imported into the computer using power post-processing software for editing and conversion to Daoheng format.

Electrical surveys:

1. The PowerPoint measurement of attribute collection, through the drop-down list

of quick selections, provides all the attributes and collection methods compatible with Daoheng software. Using the post-processing software can be exported as DaoHeng SLGPS form data (*.oog) and SLGPS interface type II format (*.txt).

2. Real-time display of the current point to the current reference line of the various positional relationships, handbook electronic compass, intuitive graphic display.

3. Provides a wealth of auxiliary functions, calculating the offset of a point to a straight line, calculating the height difference between the distance of two points, corner calculation, adding an angle bisector, setting reference points, offset storage, offset point calculation, and so on. For the points that can not be reached you can use offset storage, and offset point calculation to get the collection point.

4. Add the power auxiliary line, through the drop-down list to select the current reference line, the current reference line using the red display.

Pole tower placement, tower base cross-section measurement:

1. Provides sub-pit design for poles and towers, adds piles at specified locations, and adds straight piles.

2. Through the drop-down list can quickly select the pile number, and sub-pit, providing clear graphic information as well as indication information, convenient for users to quickly move to the location of the stakeout line for release.

3. Tower base section measurement data imported into the power post-processing software, can be converted to a Daoheng section file (*.org), in Daoheng software to form the section map. The handbook can also be exported to customized formats, AutoCAD formats, etc.

1.2 Software Features

1. Business logic is clear and concise, the operation process is simple, the interactive interface is friendly, and the interface is hierarchical.

2. Drawing powerful, the use of multi-touch, graphic zoom operation, drawing operation interaction, finger touch screen operation is smooth, object capture drawing more convenient, graphic data and southern CASS compatible.

3. The broken part of the measurement provides a graphical interface and text measurement interface, like to use the code mapping users can use the text interface.

Support dwg, dxf base map import, boundary line set out of bounds reminder. Support the export of various data formats, when exporting the graphic will be spread point number, elevation points exported at the same time, filtering disabled elevation points.

4. Using the advantages of the Android system, make full use of the hardware functions of the Android handbook for data collection, such as taking pictures, audio and video recordings, parameter generation of QR codes, scanning QR codes to obtain data, and using third-party communication software to share data.

5. CAD drawing import, capture any point on the screen for sampling, select the imported base map line for sampling; and support TIF image map import as base map.

6. Software online automatic detection of updates and upgrade tips.

7. Every screen has a help button to view a detailed description of the current function.

8. The analog measurement function is convenient for users to familiarize themselves with the use of software.

9. Provide offset measurement way to measure hidden points, making RTK measurement house more convenient.

10. A wealth of auxiliary tools, area measurement on the map, area parcel information entry, staggered topology checking, so that the external land acquisition survey and others are more convenient.

11. With coordinate quality inspection function, cadastral and real estate coordinate inspection, and measurement, directly export error statistics table.

Chapter II. Projects

2.1 Project Management

The first page of the main interface of the software is the project management

page, as shown in Figure 2.1.

Figure 2.1

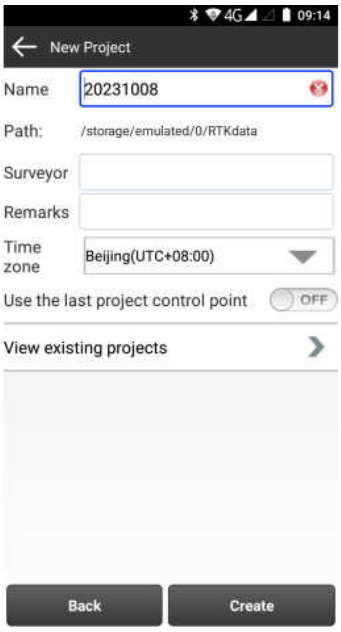


Figure 2-1

Figure 2-2

2.1.1 New Construction Projects

In the main interface, click [Project] - [New Project] to enter the new project form, as shown in Figure 2-1. Default use the date of the day as the project name, the default save path for the SD card under the GoodSurveyRTK file, click [Select] to modify the save path, the project file suffix is prj, saved in the same name as the project name of the folder, click [New] to complete the new project. After the new project is successfully created, a pop-up window will appear to set the coordinate system, and you can set the parameters of the coordinate system.

The "Time Zone" is the time zone where the difference between the local time and the GPS time is, you can select from -12 time zone to +12 time zone in the drop-down list, and the default time is Beijing time.

[Using the parameters of the last project] When you create a new project, apply the parameters of the last opened project, including ellipsoid parameters, projection parameters, seven parameters, four parameters, elevation fitting parameters, and point correction parameters.

[Using the control points of the last project] When you create a new project, copy

the control point file of the last project to the current project.

2.1.2 Delete Projects

[View Existing Projects] Open the list of existing projects, in the list of existing projects, long press (1 second or so) a project folder, you can click on the bottom of the [Delete] button to delete the project, there are two ways to choose between direct deletion and backup deletion. One of the backup deletions is to compress the project into a zip file to save the backup before deleting the project file, the compressed file is saved in the project directory, in order to provide users with a remedy for misuse.

2.1.3 Open Projects

In the main interface click [Project] - [Open Project] to enter the open project form, in Figure 2-2, click a project folder, select the following prj file, and click [Open].

In the main interface, click [Project] - [Recent Projects] to enter the Recent Projects form, as shown in Figure 2-3. List the recently used projects, easy to quickly find open projects, long press a project in the list can be opened.

2.1.4 Projects Information

In the project information window you can view the current project coordinate system, measurement point information, and graphical information, as shown in Figure 2-4.

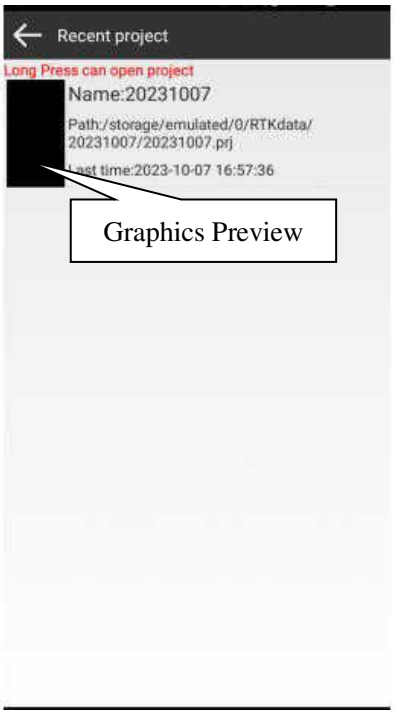


Figure 2-3

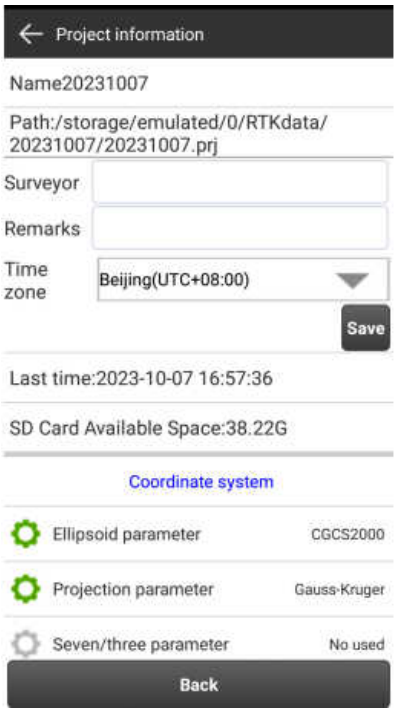


Figure 2-4

2.2 Coordinate System

The coordinate system interface includes five pages: projection selection, datum conversion, plane conversion, elevation fitting, and point correction.

[Save] Saves the parameters of all pages.

Note: When using the parameters, be sure to check the "Use Parameters" box and click the [Save] button to take effect!

[Cancel] Closes the coordinate system form.

[Encryption] Check the box to encrypt the parameters of the current coordinate system, and the password needs to be 1-6 digits. After encryption, all parameters will be invisible, after encryption, enter the password to cancel the encryption.

2.2.1 Ellipsoid

The ellipsoid set here is the target projection ellipsoid (the source ellipsoid is WGS84 by default), and the receiver directly outputs the latitude and longitude under the WGS84 ellipsoid, and the program projects the latitude and longitude coordinates of the WGS84 ellipsoid directly to the target ellipsoid if the seven parameters are not

set. If the seven parameters are set, the latitude and longitude coordinates under the WGS84 ellipsoid will be converted to latitude and longitude under the target ellipsoid and then projected to the target ellipsoid.

As shown in Figure 2-5, select the corresponding ellipsoid in the drop-down box of the name column according to different regions, the long semiaxis and the inverse of the flatness need not be set.

2.2.2 Projector

As shown in Figure 2-5, the projection methods include Gaussian projection, UTM projection, orthogonal Mercator projection, transverse Mercator projection, Lambert equirectangular conic projection, and web Mercator projection. When the projection mode is Gaussian projection and the third-degree belt or sixth-degree belt is selected, the instrument supports automatic calculation of the central meridian longitude after connection. If you don't know the longitude of the local standard sub-belt, you can click the button after connecting the receiver and automatically calculate the central meridian of the third-degree belt or sixth-degree belt.

Note: The angle in the software is entered in a fixed format of degrees, minutes, and seconds, e.g., "111:31:05.10000E" means 111 degrees, 31 minutes and 5.1 seconds east longitude, when entering longitude, E means east longitude and W means west longitude, when entering latitude, N means north latitude and S means south latitude. Place the cursor in front of the number or letter that needs to be modified, and enter the characters on the keyboard.

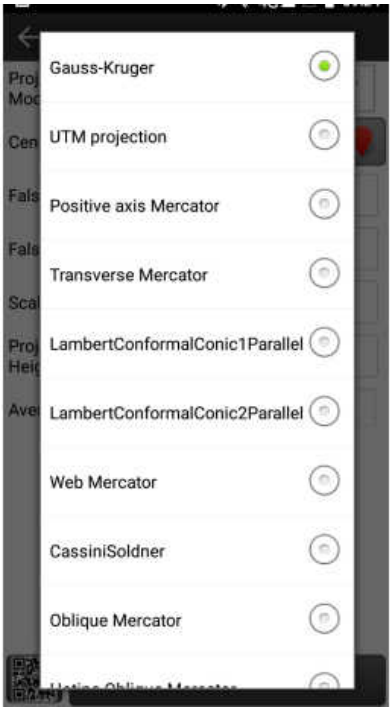


Figure 2-5

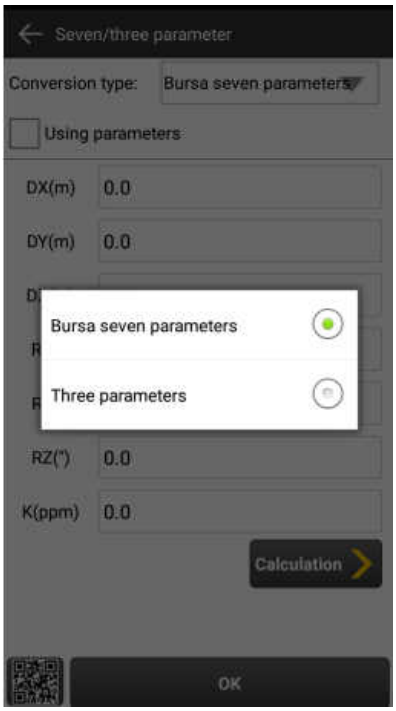


Figure 2-6

2.2.3 Base Conversion

The ellipsoidal datum conversion is shown in Figure 2-6, including two types of Bursa seven-parameter and three-parameter.

1. Bursa Seven Parameters:

When the survey area is large, generally more than 50 square kilometers, it is recommended that seven parameters are appropriate for conversion to ensure the accuracy of the conversion. When calculating, users need to know at least three known points of local coordinates and WGS-84 coordinates, i.e., WGS-84 coordinates converted to local coordinates of the seven conversion parameters. The format of the seven parameters is X translation, Y translation, Z translation, X-axis rotation, Y-axis rotation, Z-axis rotation, and K scaling. The seven conversion parameters have reference limits, X, Y, and Z axis rotation generally must be seconds; X, Y, and Z axis translation generally should not be greater than 1000m.

If the derived seven-parameter is not within this limit, it generally cannot be used. This limit is still rather harsh, so the specific use of seven or four parameters should be based on the specific situation of the survey area.

Note: It is preferable that the area consisting of the points for calculating the parameters covers the entire survey area, which is more effective.

2. Three Parameters:

The three-parameter concept is actually an extension of the seven-parameter one, which, when it does not take into account the rotation of the axes and scale ratios, has only translational parameters, and is mostly used in small, less demanding survey areas.

2.2.4 Plane Conversion

The plane conversion is shown in Figure 2-7, and the conversion method is four-parameter.

Four Parameters: the parameters of translation, rotation, and scaling ratio between two plane coordinate systems, which are applicable to most ordinary projects. The control points involved in the calculation should in principle be at least two or more points, and the level and distribution of the control points directly determine the control range of the four parameters. Empirically, the ideal control range of the four parameters is generally within 20-30 square kilometers. The scaling parameters are generally very close to 1.

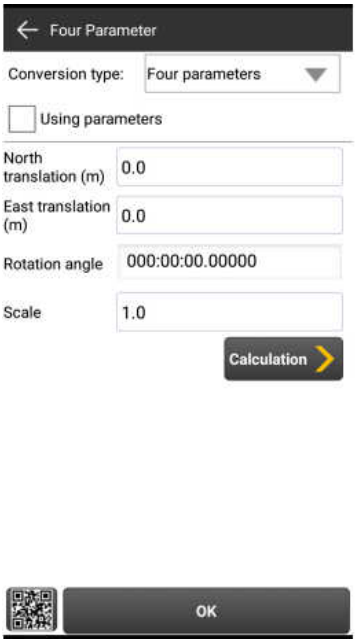


Figure 2-7

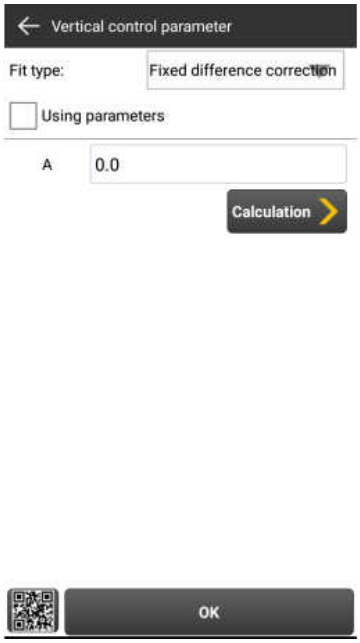


Figure 2-8

2.2.5 Elevation Fitting

Elevation fitting is shown in Figure 2-8, with three options: fixed difference correction, plane fitting, and surface fitting.

1. Fixed Difference Correction: only one parameter, the translation parameter, requires at least one point to calculate.

2. Plane Fitting: contains 3 parameters and a center point coordinate, at least 3 points are needed to calculate.

3. Surface Fitting: contains 6 parameters and a center point coordinate, at least 6 points are needed to calculate.

2.2.6 Point Correction

There are two ways to obtain WGS84 coordinates: one is to read the current single-point positioning latitude and longitude coordinates directly from the reference station (GNSS coordinates are refreshed every second, and there are differences in the coordinates read at each time, with a difference of about 1 to 2 meters); the other one is to lay a good static control network beforehand, and obtain them from the results of the static processing. Because of the relative uncertainty of WGS84 latitude and longitude acquisition in solving the conversion parameters must first determine a group of public control points of WGS84 latitude and longitude coordinates, this group of coordinates must be determined each time after the start of the reference station to use this group of WGS84 latitude and longitude coordinates, otherwise, the use of the conversion parameters of the display coordinates and the actual construction of the coordinates of the existence of a fixed bias between the deviation of the WGS84 coordinates taken by the reference station. This deviation is caused by the difference between the WGS84 latitude and longitude coordinates of the reference station and the WGS84 latitude and longitude coordinates used to calculate the conversion parameters.

The coordinates taken when using the automatic startup datum station (without duplicating the station) are the WGS84 latitude and longitude coordinates taken automatically after the datum station is powered on and has reached the positioning

state, which results in the fixed deviation described above, which is corrected by the software through the transformation parameters (3 translation parameters) derived from a common known point.

As shown in Figure 2-9, the point correction parameters include north coordinate, east coordinate offset, and elevation correction. The interface of point correction parameters does not support manual input, but it can be input manually in the interface of calculating parameters or obtained by point coordinate calculation.

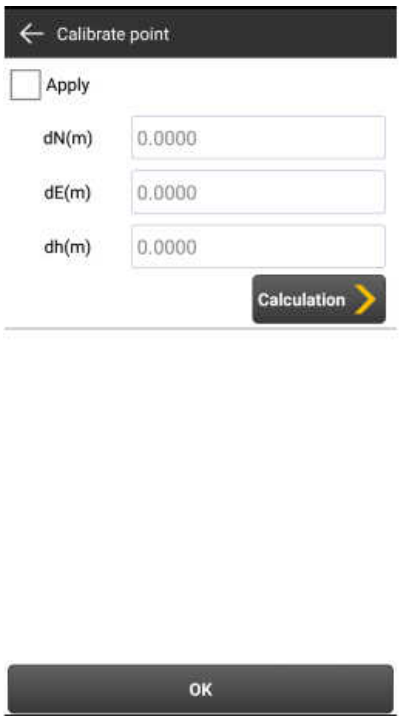


Figure 2-9

Figure 2-10

2.2.7 QR Code

Click the QR code button on the corresponding parameter page to enter the QR code form, as in Figure 2-10, it will automatically generate the QR code of the corresponding parameter (the newly entered parameter is valid only by clicking Save), and the parameter of each page will generate the QR code respectively, and the other handbook can get the parameter by scanning the QR code.

[Scanning QR Code] Scan the QR code pictures generated by other handbooks to get the parameters. When scanning, place the QR code picture completely in the

scanning frame, and the parameters will be displayed when the scanning is successful. Click [Apply] to apply the scanned parameters or coordinate data to the project.

Note: When the QR code is completely placed in the scanning frame, please move the camera back a certain distance to scan it for easier recognition.

[Cancel] Close the QR code form.

[Share] You can share the generated QR code with other users via third-party software (QQ, WeChat, etc.).

[Save] Save the QR code image of the current parameter to jpg format.

If the current parameters have been encrypted, the scanning success prompts you to enter the password to get the data.

Checking [Generate All Coordinate System Parameters] generates a QR code for all projection parameters, seven parameters, four parameters, and elevation fitting parameters. Scanning the QR code of all parameters can deliver all parameters at once.

Notes:

1. Seven parameters also have the function of correcting elevation, in the case of using seven parameters and elevation fitting parameters at the same time, the elevation will use the results of elevation fitting calculation.

2. When the seven parameters and four parameters are enabled at the same time, the seven parameters will be converted first, and then the four parameters will be used for plane conversion!

2.3 Parameter Calculation

2.3.1 Calculation of Coordinate Transformation Parameters

Parameter calculation is used to calculate the conversion parameters between two coordinate systems, and the types of parameter calculation include "seven-parameter", "three-parameter" "four-parameter", "Four-parameter + elevation fitting", "elevation fitting", as shown in Figure 2-11.

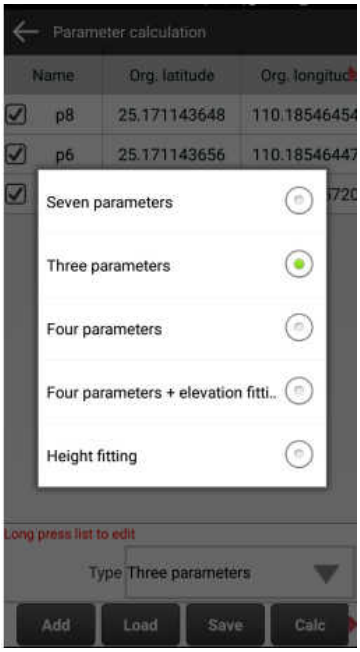


Figure 2-11

Figure 2-12

[Add] Enter the Add Point Pair form, as in Figure 2-12, to add the coordinates of the point par, the source point coordinates can be manually input or measured, and the point library, and map selection method to obtain, the target point can be obtained from the point library or map selection. When you need to operate the selected points, long press a point data in the list to enter the multi-select mode, and you can edit or delete it. When the calculation type is "4-Parameter + Elevation Fitting", the Add Point Pair form has two options, "Plane" and "Elevation", whether to use the current point pair to calculate the plane and elevation. The checkbox in front of the point name allows you to choose whether or not to use this point in the calculation.

The source point coordinates of seven parameters or three parameters are in latitude/longitude format, and the source point coordinates calculated by other parameters such as four parameters are in plane coordinate format. If the source point coordinates are in latitude/longitude format, you can enter the latitude/longitude coordinates into the control point library (add control points to the control point library) before selecting them from the list.

[Save] Save the point-to-coordinate data of the current list as a file (*.txt), as in Figure 2-13.

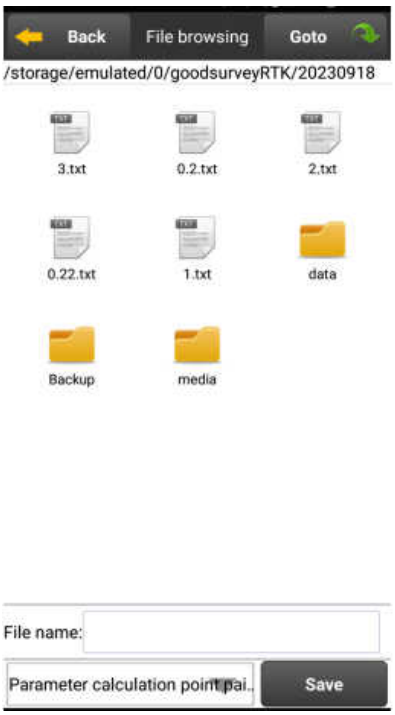


Figure 2-13

Figure 2-14

[Load] Load data from a point-to-point file.

[Calculate] Carry out the parameter calculation, the calculation result form pops up when the calculation is completed, as in Figure 2-14, click [Apply] to apply the parameters to the current project. You can view the calculated residual values of each point in the last two columns of the data list in Figure 2-11: HRMS horizontal residual; and VRMS vertical residual. Generally, the residual value is less than 3cm and the accuracy of the point is considered more reliable.

[Cancel] Close the Calculation Results screen.

Seven Parameters

When the survey area is large, generally more than 50 square kilometers, it is recommended that seven parameters are appropriate for conversion to ensure the accuracy of the conversion. When calculating, users need to know at least three known points of local coordinates and WGS-84 coordinates, i.e., WGS-84 coordinates converted to local coordinates of the seven conversion parameters. The format of the seven parameters is X translation, Y translation, Z translation, X-axis rotation, Y-axis rotation, Z-axis rotation, and K scaling. The seven conversion parameters have reference limits, X, Y, and Z axis rotation must be generally seconds; X, Y, and Z axis translation should not be greater than 1000 m. If the seven parameters are not within

this limit, generally can not be used.

Three Parameters

The three-parameter concept is actually an extension of the seven-parameter one, which, when it does not take into account the rotation of the axes and scale ratios, has only translational parameters, and is mostly used in small, less demanding survey areas.

Four Parameters

The parameters of translation, rotation, and scaling ratio between two plane coordinate systems are applicable to most common projects. At least two control points are required to participate in the calculation, and the level and distribution of the control point directly determine the control range of the four parameters. Empirically, the ideal control range of the four parameters is generally within 20-30 square kilometers. The scaling parameters are generally very close to 1.

Elevation Fitting

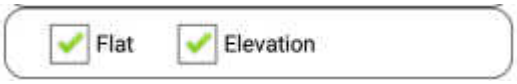
1. Fixed Difference Correction: only 1 parameter, the translation parameter, at least 1 point is needed to calculate.

2. Plane Fitting: contains 3 parameters and a center point coordinate, at least 3 points are needed to calculate.

3. Surface Fitting: contains 6 parameters and a center point coordinate, at least 6 points are needed to calculate.

Four Parameters + Elevation Fitting

Calculate the four parameters and elevation fitting parameters at the same time, as in Figure 2-15, when adding the point pair, check the plane and elevation, the top and bottom of the checkbox of the point name will show "plane" and "elevation", which means that this point pair will participate in the calculation of the four parameters and elevation fitting parameters at the same time.



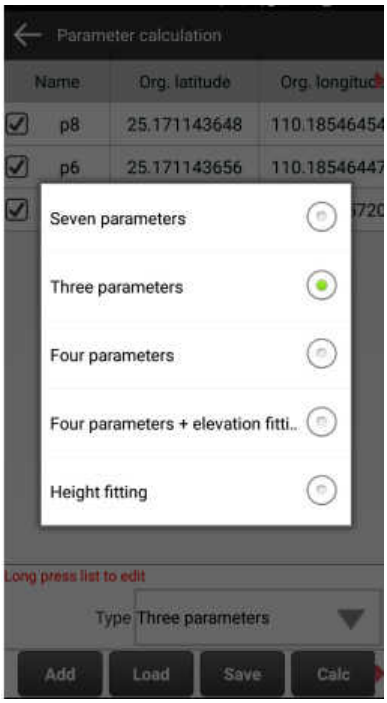


Figure 2-15

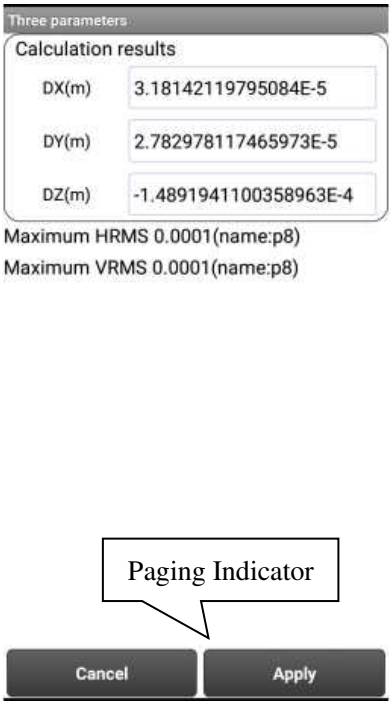


Figure 2-16

The calculation results are shown in Figure 2-16. The four-parameter results and the elevation fitting results are divided into two pages for display and can be switched by sliding left and right.

Note: The point pair data used to calculate the seven-parameter and three-parameter can not be used for the calculation of the four-parameter and elevation fitting parameters, these two types of point pair data can not be generalized, and the calculation of these two types of parameters need to select the point pair data separately!

2.3.2 Calculation of Point Calibration Parameters

Used to calculate plane and elevation translation parameters between two coordinate systems. Usually, the point correction parameter can be used in the following two cases:

1. Only one Beijing 54, national 80 coordinates or only one and WGS84 coordinate system rotation is very small under the coordinate system, the reference station set up, the mobile station can be direct to a known point, measurement of the current known point of the WGS84 coordinates, input the local coordinates of the

known point, click on the [Calculate], the known coordinates and the current coordinates of the amount of correction of dx, dy, dz, click on the [Apply]. After applying the calibration parameters, the coordinates of the measured point will be automatically corrected to the coordinates of the same coordinate system as the known point by the calibration parameters.

2. Assuming that a project has been built after the parameters are calculated, the normal work for a period of time, due to objective reasons, the second operation does not want to set up the reference station and the first time the same location, at this time, you can use the point correction function, just the reference station arbitrarily set up, open the first use of the project, move the station to a known point (can be the last measurement of the fragmentation point) on the correction coordinates can be. The correction method is the same as in the first case.

Notes:

1. If the base station is set up in the same position every time, but the coordinates of single-point measurement are used to start up every time, point correction is also needed.

2. If the datum station is set up in the same position (if there is any change in the height of the instrument, it is necessary to re-measure and set it up), and the base station uses the last WGS84 coordinates to start the datum station by default every time the base station is turned on, then there is no need to carry out the point correction.

3. If the datum station is set up at a known point and starts with single point coordinates, the mobile station can enter the known point coordinates of the datum station anywhere for correction after receiving the datum station startup coordinates.

4. If the datum station is set up at an unknown point, then the mobile station must go to the known point to enter the known point coordinates, measuring the current coordinates to carry out corrections.

Calibration Methods:

As shown in Figure 2-17, point correction in the calculation page to select a known point, the source point can be manually input or measured directly on the

known point to obtain, click [Calculate] to switch to the "Results" page, as shown in Figure 2-18, check [Apply] click [OK] to save the parameters. Check [Apply] after the "current point" shows the coordinates of the corrected point, the receiver will be placed on a known point to check whether the corrected coordinates are correct.

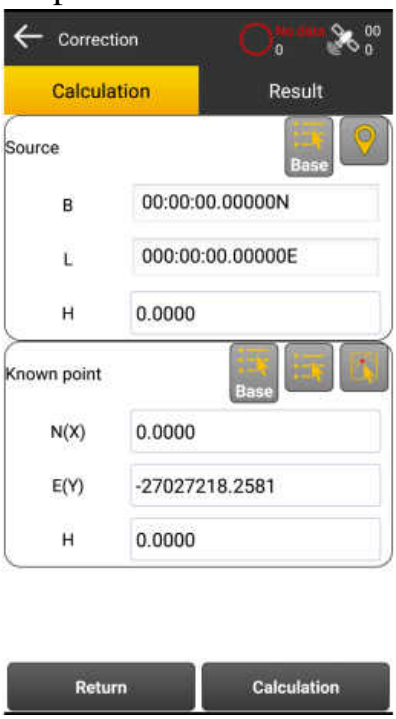


Figure 2-17

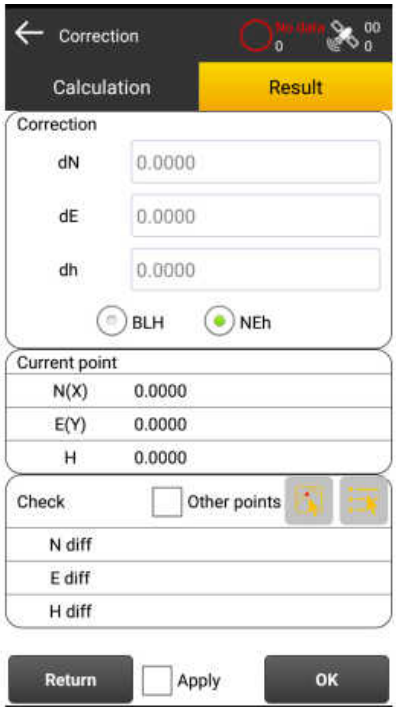


Figure 2-18

Check [Manual Input] if [Application] is unchecked to input the correction amount manually, and the receiver must be in the positioning state when inputting manually.

BLH means the correction amount is displayed in latitude and longitude format, and NEZ means it is displayed in meters.

If the base station is set up in the same location and a single point coordinate is used for each power-up instead of repeated station setup, if the software records the current base station coordinate and the first base station coordinate, then you can select the current base station to coordinate at the source point and the first base station coordinates at the known point, and you can calculate the difference between the two base stations. When selecting the base station coordinates, the last row of the coordinate list is the current base station coordinates, and the last column can view the recording time of the base station coordinates. Every time the base station coordinates change, the software will record the base station coordinates.

2.4 Coordinate Data

The coordinate data interface is shown in Figure 2-19, which is divided into three interfaces: measurement points, stakeout points, and control points. When the number of points exceeds 100, it will be displayed on pages, 100 points per page.

2.4.1 Measure Point

Displays measured fragment points. Measured points cannot be added manually, but can only be obtained by measuring or importing a handbook point library file.

[Find] Enter the characters contained in the point name to find, as shown in Figure 2-20, and Figure 2-21 for the results of the search, click [Refresh] can return to the list of coordinate points.

[Graph Selection] As shown in Figure 2-22, by single-touch screen drag the box to select the point, two-touch screen can move and zoom the graph. The selected point symbols are displayed in blue. [Cancel Selection] You can cancel the selection. Repeating the box selection will clear the last selection each time. You can [Modify] the point data only when only one point is selected.

Figure 2-19

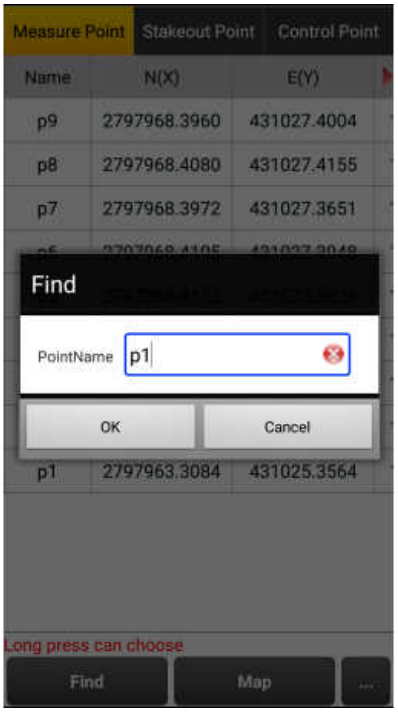


Figure 2-20

Figure 2-21

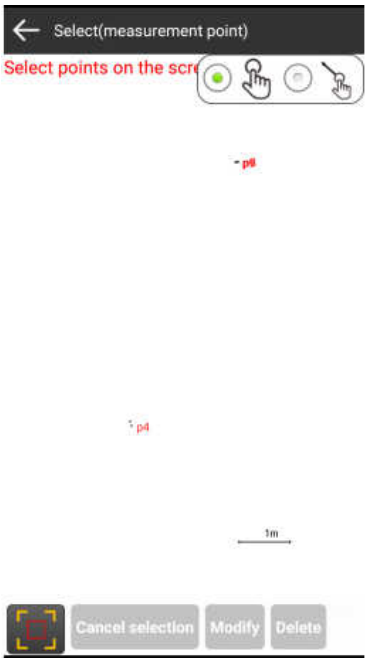


Figure 2-22

[Selection Mode] Long press any point in the list of points to enter the selection mode, enter the selection mode when the bottom toolbar is yellow, such as Figure 2-23, at this time through the click or long press to select multiple points, has been selected by the point of click again will be deselected, select the point of mode, click the handbook return key to exit the selection mode.

In the case of selecting only one point, you can modify the point, positioning to the map, and coordinates to generate two-dimensional code, such as Figure 2-24.

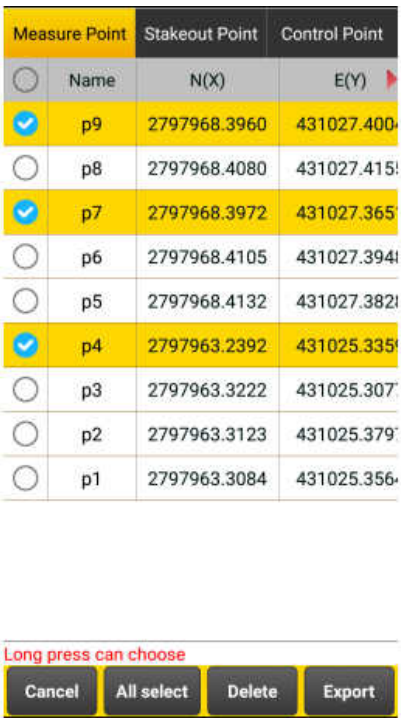


Figure 2-23

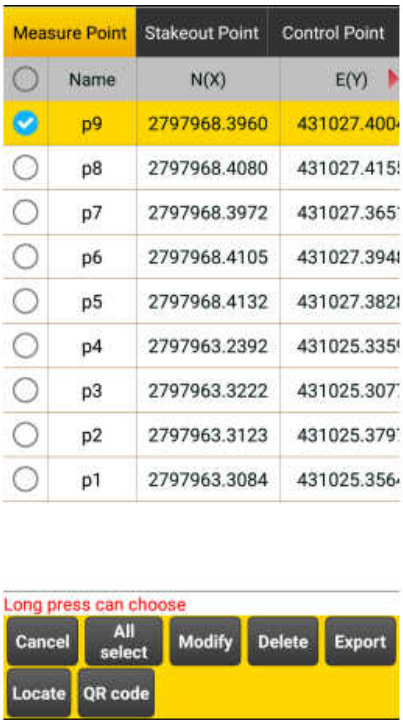


Figure 2-24

[Modify] You can modify the point name, code, and antenna height of a measurement point, as in Figure 2-25.

Figure 2-25

Figure 2-26

[Positioning on The Graph] Centers a selected point in the graphical interface to visually display the location of the point.

[Coordinate Generation QR Code] Generate a QR code for the plane coordinates

and elevation of a selected point to share this coordinate data, as in Figure 2-26.

2.4.2 Stakeout Point

As in Figure 2-27, the imported stakeout points are displayed, and in the "Import and Export" interface, you can import stakeout points through files. Selection mode and the same method of measuring points, selecting a stakeout point can be modified, such as Figure 2-28.

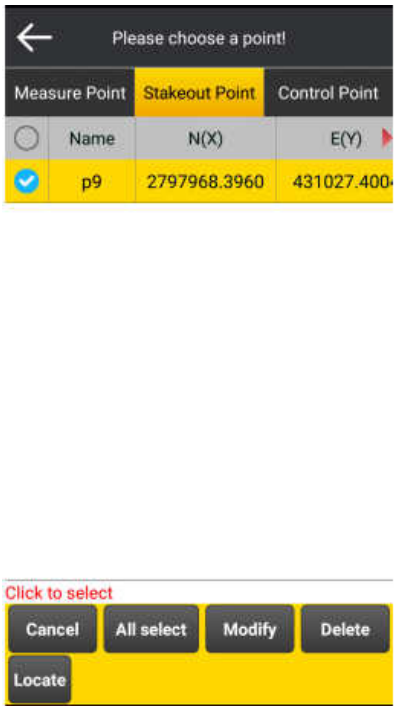


Figure 2-27

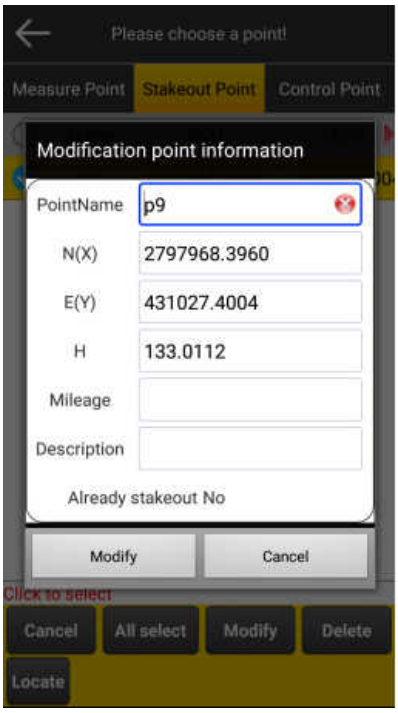


Figure 2-28

2.4.3 Control Point

As shown in Figure 2-29, control points can be obtained by measurement, manual addition, and file import.

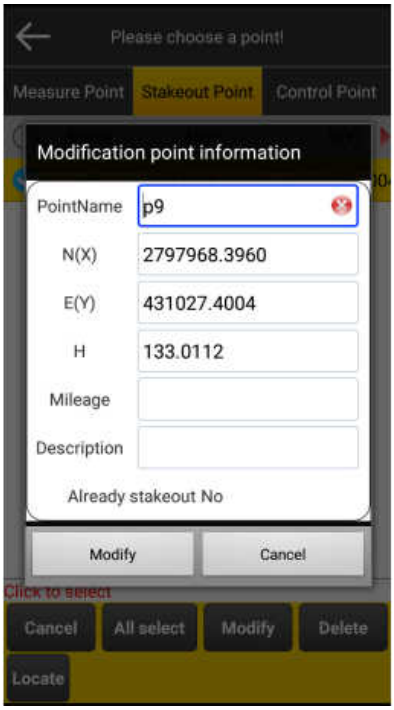


Figure 2-29

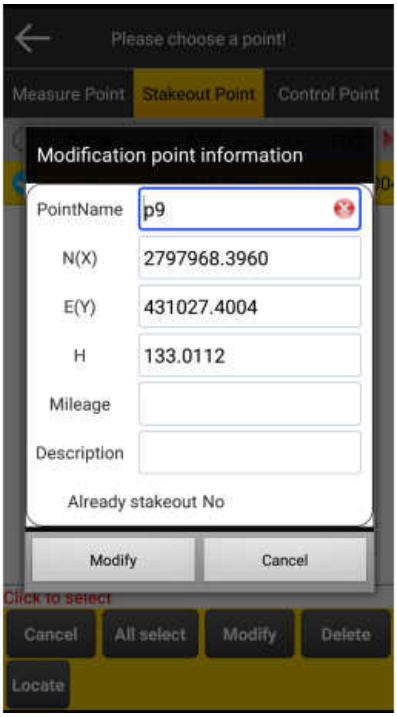


Figure 2-30

[Add] Add control points manually, as in Figure 2-30, you can manually enter the coordinates of the control points. BLH inputs WGS84 latitude, longitude, and geodetic height, and NEh inputs local plane coordinates and elevation. When switching between BLH and NEZ, the input coordinates are forward and backward calculated according to the coordinate system parameters of the current project. The coordinate source can be obtained by scanning the QR code, point library already point selection, and map selection already point.

2.5 Import and Export

Export the graphic data, original measurement point data, stakeout point library, and control point library in the project to different formats or import the data from the file to the handbook.

The default path of export is the "data" file in the project path, you can choose the path of export, and the program will create a new "data" folder under the chosen path, and the data will be saved in it.

The default file name of the exported file is the same as the project file name, if there is a file with the same name in the data export file directory, you will be

prompted that the file already exists, and clicking "Overwrite" will overwrite the existing data.

2.5.1 Measure Point

Export

As shown in Figure 2-31, the original measurement point file (*.pot) cannot be opened and used directly on the computer, and the measurement point must be converted to other formats to be used on the computer. Measured point data can be exported in the following formats: Southern CASS7.0 (*.dat), customized (*.txt), customized (*.csv), AutoCAD (*.dxf), kml file (*.kml), shp file (*.shp), coordinate checklist (*.xls).

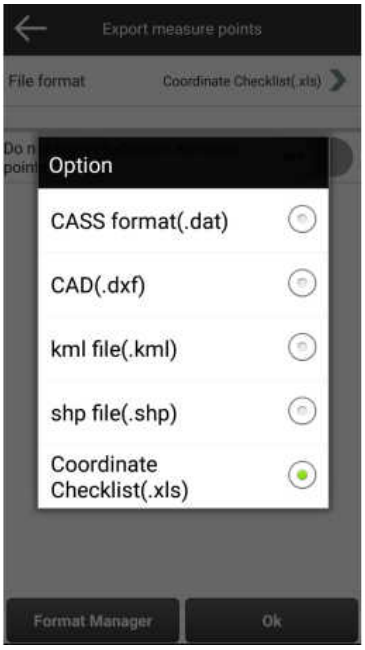


Figure 2-31

Figure 2-32

Measured points exported in dxf graphic format are a point symbol + point name, which can be associated and selected when the CAD grouping is opened, and saved in the ZDH (Spread Point Number) layer.

Points collected using the line measurement function will be automatically added to the code ("L" for the start of the line code, "+" for the connection of the last point code), exported to the southern CASS7.0 format will export these codes. Using the CASS short code recognition function can automatically connect the line.

[Recalculate exported coordinates using current coordinate parameters] After the measurement is completed, if the coordinate system parameters have been changed, you can recalculate the coordinates using the currently set parameters when exporting the coordinate data, including projection, datum conversion, plane conversion, and elevation fitting (not including point correction). It only recalculates the exported coordinates and does not modify the coordinates in the point library. Modification of coordinate parameters exported can not modify the graphics.

[Filter elevation disabled points] When checked, the points marked as elevation disabled during measurement will not be exported.

[Export] Open the export interface, as in Figure 2-32, click on the upper layer to select other paths, and click Save to complete the export.

How to customize the export format

If you select Customize (*.txt) or Customize (*.CSV), click the [Define Format] button to enter the customization interface, as in Figure 2-33.

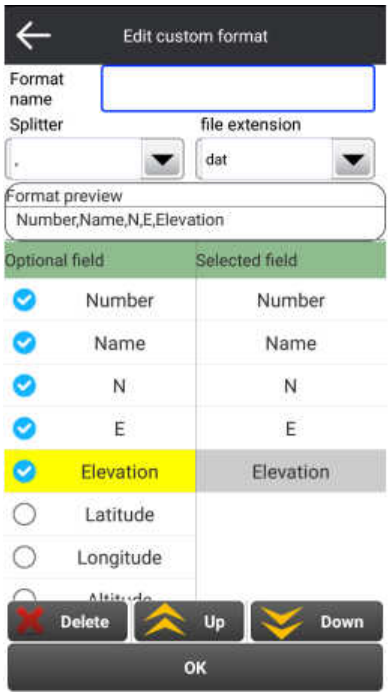


Figure 2-33

1. Click on the "Optional Fields" list option, and the selected fields are automatically populated into the "Selected Fields" list, you can sort the fields by moving up and down, and you can delete the selected fields by deleting them. The "Output Content" also displays the currently selected fields in order.

2. [Settings] button can be angular format, floating-point precision (coordinates of the number of decimal places), split symbols, and whether or not to include the format file header settings, click [OK] to complete the setup.

3. Select the fields to complete and click [OK] to complete the custom formatting, in the export interface click [OK] to complete the export.

2.5.2 Graphs

Export

Graphic files (*.gsc) drawn by the current project can be exported to AutoCAD (dwg, dxf) and shape file (*.shp) formats.

1. CAD（dwg、dxf）File Export

The attributes, line types, layers, etc. of the plot elements with attributes are compatible with CASS. When exporting graphics, you can choose to export survey points, elevation points, area lines, ingestion icons, and ingestion file names at the same time, as in Figure 2-34.

[Export Options]

Measure Points: original measure point data, point symbol + point name, saved in ZDH (spread point number) layer, point symbol, and point name in CAD to establish a grouping, open the grouping can be associated with the selection.

Elevation Points: Elevation data of the original measurement points, point symbols + elevation notes, saved in the GCD (Elevation Points) layer, you can query the properties in CASS. When "Filter disabled elevation points" is checked, the elevation points will be marked as elevation disabled when not exported for measurement.

Area Lines: Export the range lines and notes of the area measurements to the graphic.

Recording Icons: When photos, audio recordings, and video recordings are inserted into the drawing, the icons of these symbols will be exported when the drawing is exported (inserted in the form of a reference block, on the TK layer), so that you can know where the pictures are inserted in the CAD when drawing the interior, and so on.

Recorded File Name: When you insert photos, audio, and video in the graph, the file name of these photos and so on will be exported to the graph when exporting the graph, which is convenient for users to find and view these files according to the file name. (Recorded files are saved in the media folder in the project path, you need to copy them to your computer by yourself).

2. shp File Export

When exporting the files, only polylines and hand-drawn lines can be exported, and three files with the same name will be generated for each export: a graphics file (*.shp), an attribute file (*.dbf), and an index file (*.shx). The coordinate type of the graphic file can be either geodetic (WGS84 latitude and longitude in degrees) or planar.

Import

Graphics import support import CAD (dwg, dxf) and shape files (*.shp), handbook graphics files (*.gsc), select a file format, click [Select File], in the file browsing interface, select the file and click [Open] to import.

Generally, a shape file consists of three files with the same name: a graphics file (*.shp), an attribute file (*.dbf), and an index file (*.shx). The software does not read the index file when importing the shape file but reads the attribute file if it exists. When reading the shp file, you need to choose the format of the imported coordinates: latitude and longitude (degrees) or plane coordinates (meters).

Note: The imported CAD and shp files will be displayed as the base map, and the base map cannot be edited. After importing the base map, you can view the number of elements contained in layers, set the filtering display element type, and so on, in "Settings" - "Display Settings" - "Base Map Management" in the measurement interface. "After importing the base map, you can view the number of elements contained in the layer, set the filter to display the element type, and so on.

Import Handbook Graphics File (*.gsc) allows you to import graphics files from other projects into the current project. The imported graphic will be used as the base graphic when "Use as base graphic" is checked, otherwise, the imported graphic will be added to the graphic file of the current project. If the graphic already exists in the

current project, you will be prompted with "Existing graphic data", you can choose to replace the existing data or add graphic data.

Note: The imported graphic data does not support the undo operation, you can delete the base map in "Settings" - "Display Settings" - "Base Map Management"!

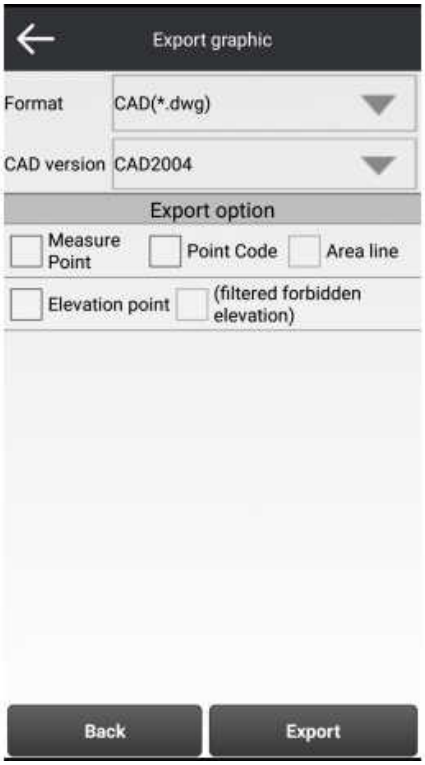


Figure 2-34

[Simple Code Recognition Automatic Linking] Import Southern CASS7.0 (*.dat) coordinate data, the software automatically connects the polyline according to the code of the point.

The rule of simple code recognition: if the code is "+" or "-", it will be judged as a line, if it is other characters, it means the began, end, or independent point of the polyline, which is similar to the recognition of the simple code of Southern CASS, but the plotted polyline doesn't recognize the attributes of the line, and it doesn't However, the drawn polyline does not recognize the attributes of the line, nor does it recognize the code of independent features, and it only draws the non-attributed polyline.

[Open] Select a data file containing the code, after opening the file, the software automatically recognizes the code to connect the lines, and the drawn polyline is stored in the current graph.

Simple code recognition is mainly to facilitate other types of instruments (no mapping function) field coding mapping, and on-site pouring into the handbook software plotting. For example, if you use the total station to measure the house in a coding way, if the total station supports an SD card to export data, then you can import the dat file to the handbook for drawing on the spot through an SD card or other means.

2.5.3 Stakeout Point

Export

You can export the current stakeout point file (*.fyp) to text (*.txt), Southern CASS 7.0 (*.dat) format, and dxf file, as in Figure 2-35.

Text (*.txt) format:

Roll Call, E, N, H, Mileage, Description, Whether Sampled (0:Not Sampled 1:Sampled)

Southern CASS format: ***Roll Call, E, N, Z***

Click [Export] to export the stakeout point file.

Import

Import the stakeout point from the file, you can import the text (*.txt) or Southern CASS7.0 (*.dat), customized format (*. *), as in Figure 2-36, select a file format, click [Select File], select the file in the file browser interface and click [Open] to import.

Text (*.txt) format:

Roll Call, E, N, H, Mileage, Description, Whether Sampled (0:Not Sampled 1:Sampled)

When importing a txt file, the mileage, description, and whether or not the sample has been placed can be empty, but the semicolon cutoff character must be retained.

When importing custom format, after selecting the file, the custom format interface will pop up, such as Figure 2-36-1, set the format and click [OK] to import. If the format is not consistent with the format of the file, it will lead to reading failure. The custom format is edited in a text file on the computer beforehand, and each line of data can be separated by commas or semicolons.

If the stakeout point already exists in the current project, you will be prompted to

add or replace the stakeout point when importing it again.

Note: Do not rename the imported stakeout point numbers, and the separator should be a comma.

Figure 2-35

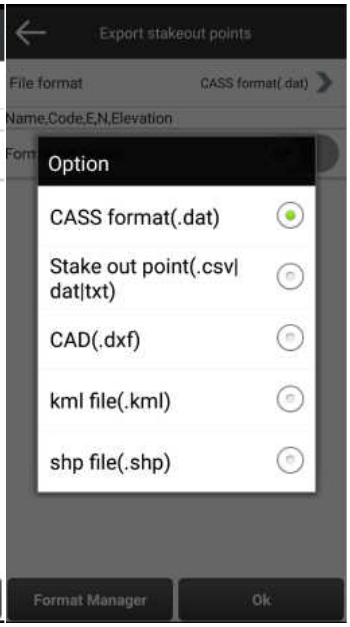


Figure 2-36

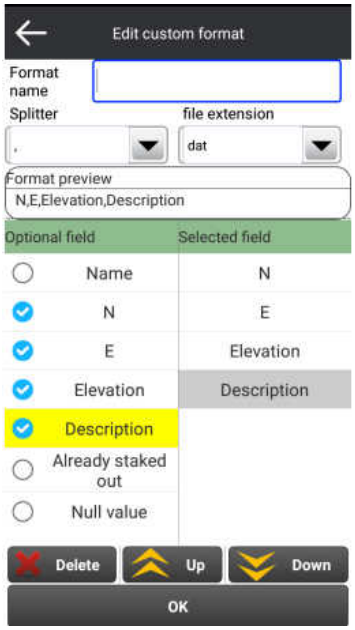


Figure 2-36-1

2.5.4 Control Point

Support Southern CASS7.0 (*.dat) and dxf format export, such as Figure 2-37, click [Export] to export the control point file. Import supports CASS7.0 (*.dat) format and customized format (*. *), as in Figure 2-38, click [Select File], select the file in the file browser interface, and click [Open] to import control points.

If control points already exist in the current project, you will be prompted to add or replace them when importing control points again.

Figure 2-37

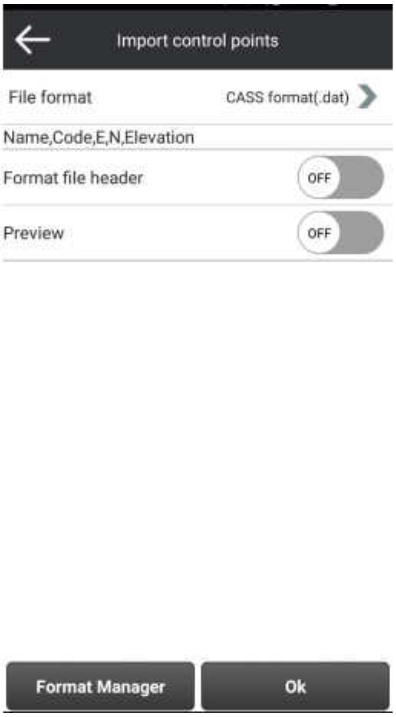


Figure 2-38

Chapter III. Instruments

The second page of the main interface of the software is the instrument settings page, as shown in Figure 3-1.

Figure 3-1

The icon state when the instrument is connected is , and the disconnected state is .

3.1 Connecting Instruments

3.1.1 Bluetooth Connection

Click [Connect Instrument] to enter the connection interface, as in Figure 3-2, the connection method selects Bluetooth, the vendor selects "GoodSurvey" when connecting the receiver of GoodSurvey, and you can also connect the receiver of other vendors, and support the parameter configuration of the receiver of some vendors.

Figure 3-2

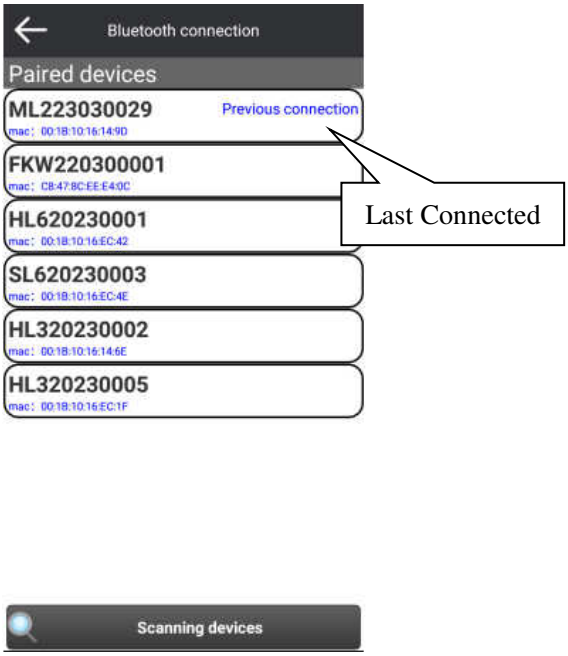


Figure 3-3

Click [Connect] to enter the Bluetooth connection interface, as shown in Figure 3-3 [Scan] Scan the nearby receiver Bluetooth, and click a Bluetooth device to connect.

Connect to The Last Device: When the connection method is Bluetooth, check [Connect to The Last Device], and try to connect to the last connected device Bluetooth when you click Connect, if you don't check it, you will enter the Bluetooth list to select the Bluetooth device again.

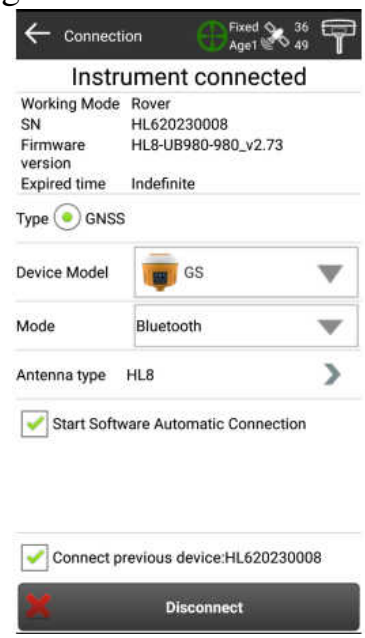


Figure 3-4

After successful connection, the current receiver operating mode, instrument number, and registration expiration time are displayed, as in Figure 3-4.

3.1.2 Connecting Handbook GPS

As in Figure 3-5, the connection method selects the handbook GPS, in the case of opening the handbook GPS, clicking on the [Connect] button program calls the handbook's own GPS data for positioning, and the handbook GPS carries out rough positioning without using the receiver.

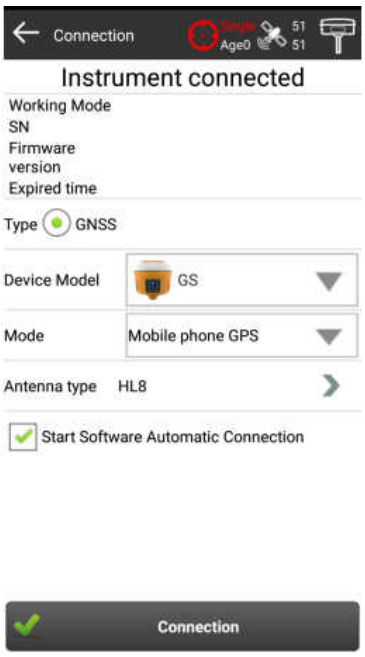


Figure 3-5

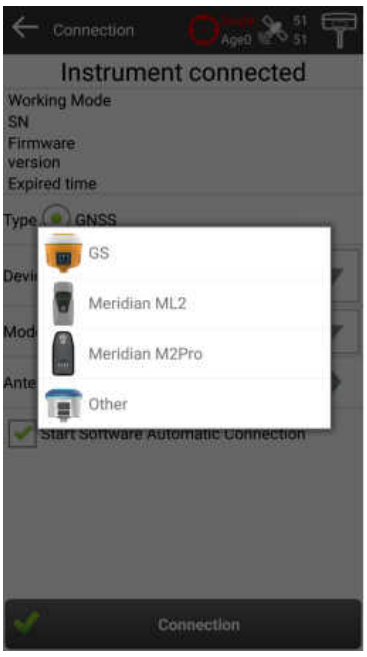


Figure 3-6

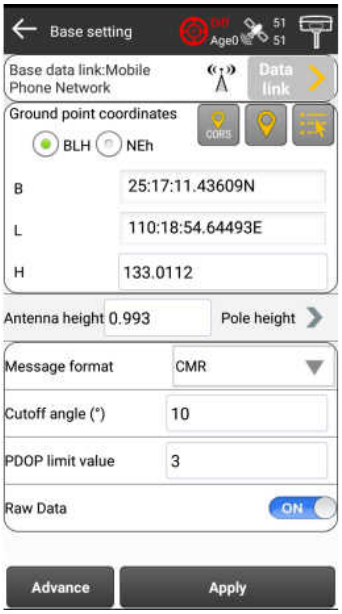
3.1.3 Connecting Total Station

As in Figure 3-6, the instrument type selects the total station, uses the handbook to connect the total station to measure, and gets the measurement coordinates for plotting in real time. Support many kinds of total station connections.

The total station does not come with Bluetooth, you need an external Bluetooth to serial cable.

3.2 Base Station Setup

Click [Base Station Setup] to enter the base station setting interface, such as Figure 3-8.



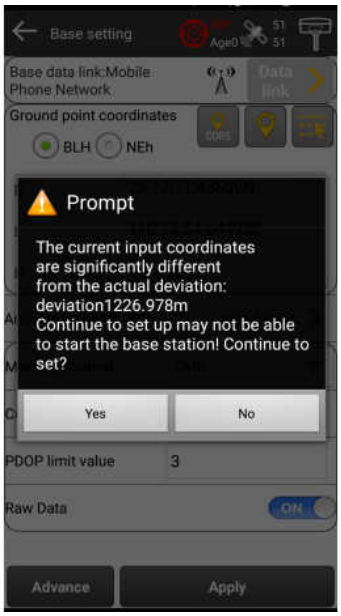


Figure 3-8 Figure 3-9

The main purpose of the base station settings is to set the base station parameters and transmitter coordinates of the base station.

3.2.1 Base Station Parameters

There are several ways to input the coordinates of the base station transmission, you can directly input the WGS84 latitude and longitude or local plane coordinates, through the point library selection, or through the base station single-point localization smoothing acquisition to obtain the WGS84 coordinates of the point where the base station is located.

When the station is set up arbitrarily at an unknown point, the height of the instrument can be left out if the coordinates of the point are collected by smoothing.

When the base station is set up on a known point on the ground and the coordinates of the known point are input, it is necessary to input the height of the instrument at this time, and the height of the instrument is generally chosen to measure the inclined height.

BLH: The input is the WGS84 latitude and longitude;

NEh: The input is the local plane coordinates (meters);

When switching between BLH and NEh, the program uses the coordinate system parameters of the current project to perform forward and backward arithmetic conversion of the input coordinates.

Note: Setting up the station at any location does not mean inputting the coordinates arbitrarily. The base station will not work when the input coordinates of the base station deviate from the actual, and the base station will be alerted if the input coordinates differ from the actual, as shown in Figure 3-9.

The next time the base station is powered on automatically start the receiver by default using the last base station coordinates to start the receiver, the premise of this way of working is that the base station must be fixed at a point to work (the instrument height can not be changed), if you move the station or change the antenna height and need to modify the parameters of the base station, it is necessary to utilize the handbook for the setup.

If the coordinates of the currently used base station differ greatly from the actual ones, the instrument will indicate the large deviation and automatically smooth the acquisition of a point as the base station coordinates.

Message Format: This refers to the differential format in which the base station transmits, mainly sCMRx (Tri-Star), RTCM3.2 (Tri-Star), CMR (Dual-Star), and RTCM3.x (Single-Star).

Note: To use Tri-Star please use sCMRx or RTCM3.2 format.

[Cutoff Altitude Angle] The altitude cutoff angle (5 to 30 degrees) of the satellites received by the base station that is involved in the solver.

[PDOP Limit Value] Limit the maximum PDOP value transmitted by the base station.

[BeiDou Satellite] Select to enable or disable the use of BeiDou.

[GLONASS Satellite] Select to enable or disable the use of GLONASS satellite.

GPS satellites are on by default, and the satellite switch will not take effect until the base station is set up successfully.

[PPK Mode] When PPK mode is turned on, the reference station records a static

file (the saved file name starts with PPK) while doing RTK. If the mobile station also turns on PPK mode at this time, PPK measurement can be carried out in the smooth acquisition boundary.

When using the PPK measurement function, the reference station and the mobile station need to record the static file at the same time and use the post-processing method to calculate the coordinates when there is no differential signal. If PPK is checked in the smooth acquisition interface, the point will be marked as a PPK measurement point. In the interface of "Import and Export", you can import the post-processing result file to correct the coordinates of the PPK measurement point.

[Setup] Click the Setup button to send the current parameters to the receiver and set it to the base station working mode. After the base station mode is set successfully, the base station button is checked .

[Data Link] Enter the base station data chain setting interface, you must set it to base station mode before you can set the data chain of the base station.

3.2.2 Base Station Data Link

Set the communication mode between the reference station and the mobile station, and the communication modes include built-in radio, built-in network, WiFi, built-in radio + built-in network, built-in radio + WiFi, and external radio.

Internal Radio

As in Figure 3-10, the built-in radio frequency can be selected by channel or customized input, and the power can be selected from high, medium, and low. Radio protocols can be selected from TRANSEOT, Trimtalk, HITARGET19200, HITARGET9600, SOUTH19200, and SOUTH9600. Compatible with other brands of radios can be selected from the corresponding protocols, for example, SOUTH protocols can be used to communicate with Southern Instruments, and HITARGET can be used to communicate with ZHONGHAIDA.

When the base station uses Tri-Star 's message format (sCMRx or RTCM3.2), it is recommended to use the SOUTH19200 protocol.

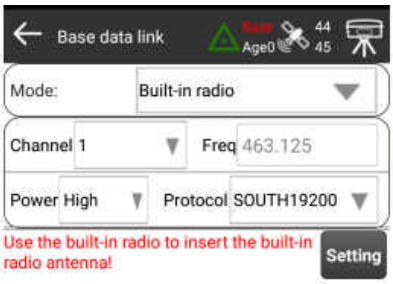


Figure 3-10

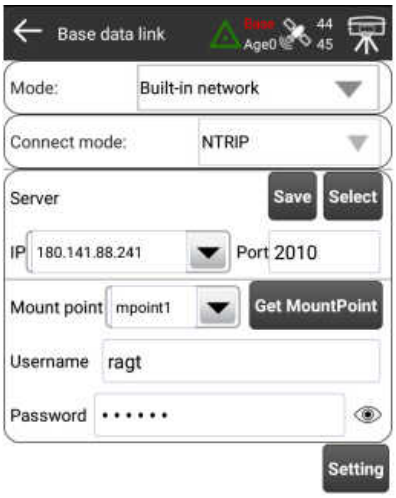


Figure 3-11

Internal Network

The receiver uses the cell phone card GPRS traffic to access the Internet and forwards the differential data through the good test server, or connects to the CORS server to get the differential data. You need to enter IP, port, source node, and password, as in Figure 3-11.

The receiver has a built-in GPRS antenna and does not need to insert an external GPRS antenna.

[Source Node] Each base station connects to the server with the source node as the unique identification number, the source node can be customized, as long as the server does not exist in the source node, if the source node already exists, the connection failure will be prompted. [Get] button to get the source node that currently already exists on the server.

[Password] Enter the connection password

[Select] button, you can select the preset server parameters in the list, or enter commonly used server parameters for easy selection, such as Figure 3-12, long press an item in the list of server addresses can be edited or deleted (the built-in default address can not be edited or deleted), click on an address can be automatically filled in the server parameters.

Click [Add] to add commonly used server address parameters, such as Figure 3-13, name, IP, port is required, access point, user name, and password can be optional. Click the [OK] button to complete the addition, [Back] to cancel the addition, and exit the add interface.

Note: For other manufacturers of mobile station receivers to connect the reference station source node established by the good test receiver, please use CORS mode to connect, at this time, the user name can be entered arbitrarily, and the source node and the password can be entered correctly.

Figure 3-12 Figure 3-13

After all the parameters are set, click the [Setup] button to set the parameters to the receiver.

Note: When setting up the built-in network data chain, the module takes a long time to initialize for the first time and connects very quickly later!

WiFi Data Link:

The host can be connected to any device with WiFi (including cell phone hotspot, router), using WiFi instead of cell phone card Internet access function, go to the network to send and receive differential data.

In the past, receivers used to send and receive differential data over a network

using a cell phone card, usually by taking out the card and inserting it into the receiver, or by running an additional cell phone card. Now the mobile station allows the user's cell phone to create a WiFi hotspot for the receiver to connect to, eliminating the need to plug in the card or run an additional card.

The parameters of the WiFi data link have more WiFi hotspot names and passwords than those of the internal network, as shown in Figure 3-14.

If you know the hotspot name and password, you can input them directly, if you want to create a hotspot or scan a hotspot, click the [Configuration] button behind the hotspot name to enter the WiFi setting interface, as in Figure 3-15. click [Scan] to scan the hotspot in the vicinity, and click the list to select a hotspot to fill in the hotspot name input box.

If you want to create a hotspot for the receiver to connect, you can turn on the shared hotspot in the system settings of the handbook.

Please refer to the settings of the internal network for server parameters.

After all parameters are set successfully, click the [Setup] button at the bottom to set the parameters to the receiver.

After setting the WiFi data link successfully, the receiver will automatically connect to the WiFi hotspot internet connection server.

Figure 3-14

Figure 3-15

Internal Radio + Internal Network

As shown in Figure 3-16, the use of the internal radio and the internal network to

send differential data simultaneously is limited to the use of the base station, at which time the mobile station can choose to use the radio or the network (internal network or WiFi) in order to receive the differential data.

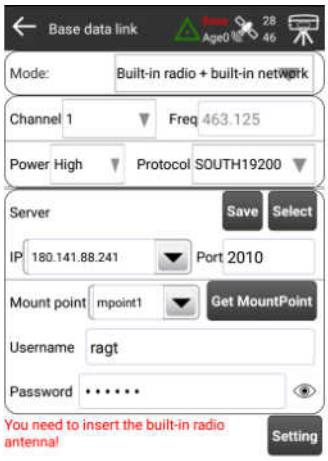


Figure 3-16

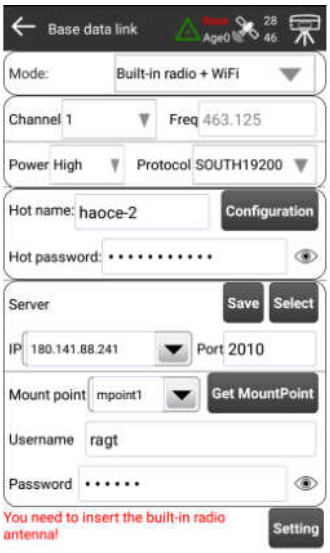


Figure 3-17

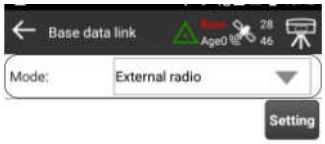


Figure 3-18

Internal Radio + WiFi

As shown in Figure 3-17, the simultaneous use of the internal radio and WiFi Internet access to send differential data is limited to the use of the base station, at which point the mobile station can choose to use either the radio or the Internet (internal network or WiFi) to receive the differential data.

External Radio

You can choose to use an external radio in the base station mode, as shown in Figure 3-18, and the channel and other parameters of the radio are set on the host of the external radio.

3.3 Mobile Station Setup

3.3.1 Mobile Station Parameters

Click [Mobile Station Setup] to enter the mobile station settings interface, as in Figure 3-19.

Figure 3-19

[Cutoff Altitude Angle] The altitude cutoff angle (5 to 30 degrees) of the satellites that the mobile station is involved in solving.

[PDOP Limit Value] Limit the maximum PDOP value of the mobile station.

[BeiDou Satellite] Select to enable or disable the use of BeiDou.

[GLONASS Satellite] Select to enable or disable the use of GLONASS satellite

GPS satellites are on by default, and the satellite switch will not take effect until the mobile station is successfully set up.

[PPK Mode] When PPK mode is enabled, the mobile station records static files (the saved file name starts with PPK) while doing RTK. When PPK mode is turned on, PPK measurements can be made in the smooth acquisition boundary.

[Setup] Click the Setup button to send the current parameters to the receiver and set it to the mobile station working mode.

After the mobile station mode is set successfully, the mobile station button is checked

.

[Data Link] Set to mobile station mode in order to access the mobile station data link setting screen.

3.3.2 Mobile Station Data Link

Set the communication method between the mobile station and the base station. Communication methods include internal radio, internal network, WiFi, and CORS relay station.

Internal Radio

The internal radio of the mobile station is the same as that of the base station, select the channel or customize the frequency value and choose the corresponding radio protocol.

Internal Network

As in Figure 3-20, you need to enter the source node, user name, and password when connecting to CORS, and the connection failure will be prompted when the CORS account is occupied or the account password is wrong.

When connecting to the base station of the measurement server, you only need to input the source node and password, and the user name can be input arbitrarily, and the source node and password are the same as those inputted by the base station in order to connect successfully.

Note: Use the internal network without plugging the external antenna.

Figure 3-20

Figure 3-21

WiFi Data Link

The mobile station WiFi data link is a connection to a nearby WiFi hotspot (shared WiFi created by a cell phone or router WiFi, etc.) to connect to the network to obtain differential data, which requires the input of the WiFi name, password, and CORS parameters, as shown in Figure 3-21.

Handbook Difference

Handbook Differential uses a handbook network to connect to a server or log in to CORS, which requires the handbook to have Internet access (either by inserting a card in the handbook or by the handbook connecting to a nearby WiFi).

CORS Relay Station

CORS relay station is used in the case of only one CORS account for the simultaneous use of multiple mobile stations within a certain range, reducing the cost of purchasing CORS accounts for users. The relay mode is categorized into radio relay and network relay.

Note: CORS relay station mode can only be set when the working mode is a mobile station.

[Radio Relay]

One mobile station connects to the CORS server through the network and forwards the received differential data to other mobile stations through the internal radio, and this mobile station, which functions as a relay, also carries out operations normally without being fixed in one position. The data link method of the other mobile station is set to the internal radio, and the channel is correct. As in Figure 3-22, you need to enter the internal radio channel, power, CORS server, and account parameters.

If the cell phone signal is not good in the survey area, you can find a high point with a good cell phone signal and set up one mobile station fixed and motionless (also need to lock the satellite), which is specially used for the radio relay to forward the CORS differential data.

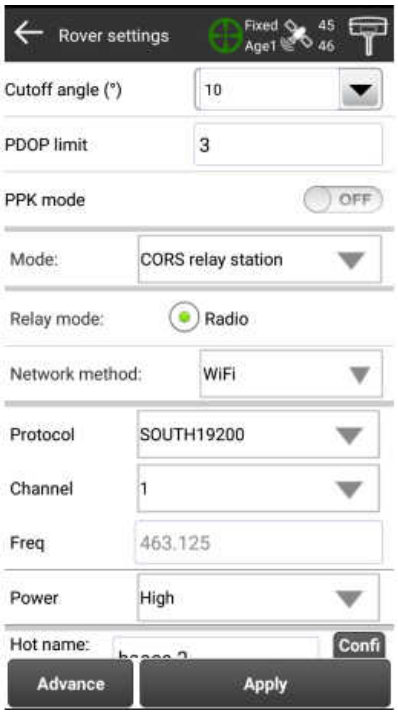


Figure 3-22

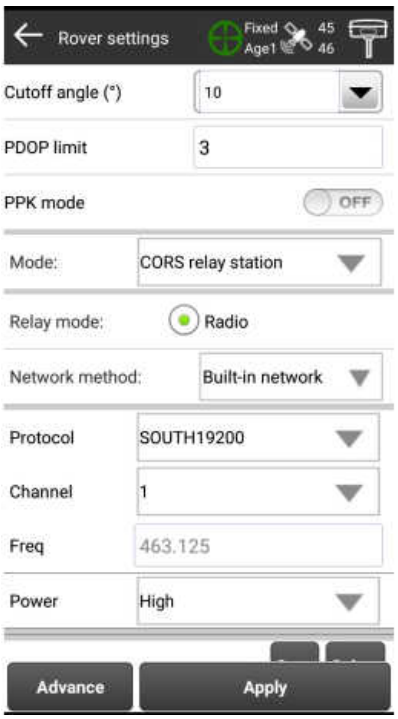


Figure 3-23

For radio relay, you need to enter the parameters of the internal radio and the parameters for connecting to the CORS server. The receiver needs to insert a cell phone card when the connection method is a internal network and enter the available WiFi hotspot name and password when it is WiFi.

[Network Relay]

The CORS differential data is forwarded through the GoodSurvey server. After setup, a source node is created in the GoodSurvey server, and other mobile stations can get the differential data by connecting to this source node.

In **"Relay Server"**, you need to input the IP and port of the GoodSurvey server, input the source node to be created, and the password, for example, the relay source node in Figure 3-23 is cors-zj (you can define it arbitrarily, it is not the same as the existing source node).

"CORS Server" needs to enter the IP, port, source node, user name, and password of the CORS server.

Other mobile stations connect to this relay source node and connect to the normal base station, such as Figure 3-23-1, enter the IP of the relay server, port, and source node, select the above-established relay source node "cors-zj", enter the password, and

click the [Set] button.

Note: Other manufacturers of mobile stations connected to the relay source node when you choose CORS connection, such as Figure 3-23-2 for the Southern Engineering Star connection method, in which the user name can be entered arbitrarily, enter the correct access point and password can be.

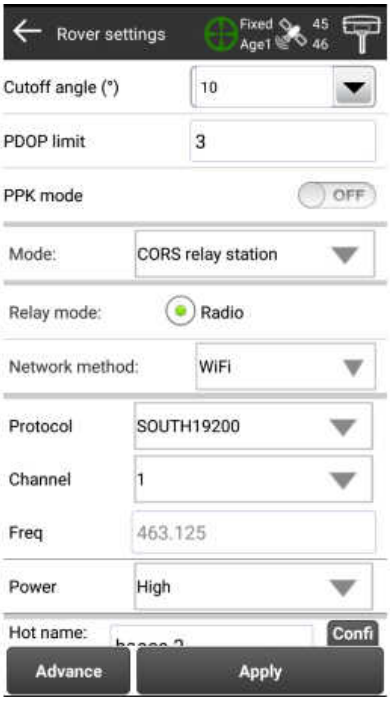


Figure 3-23-1

Figure 3-23-2

After Mobile Station A, which sets up the network relay, is successfully set up, Mobile Station A will automatically connect to the relay source node. Network interruption or shutdown of Mobile Station A during operation will not affect the established relay source node, as long as there are still mobile stations connected to the relay source node, the relay source node will continue to work. As long as there are still mobile stations connected to the relay source node, the relay source node will continue to work. If there are no receivers connected to the relay source node, the relay source node will be cleared after a certain time. The relay source node will also be cleared if the logged-in CORS account goes offline due to network abnormality of the server, etc., and needs to be reset.

When the CORS account has been used as a network relay, the mobile station uses this account again to set up the network relay, if the parameters of the relay server used are exactly the same as those of the one that has been set up, the mobile station

can directly access this source node, otherwise, it will indicate that the CORS account is occupied.

3.4 Static Setup

Click [Static Setup] to enter the static settings interface, as shown in Figure 3-24.

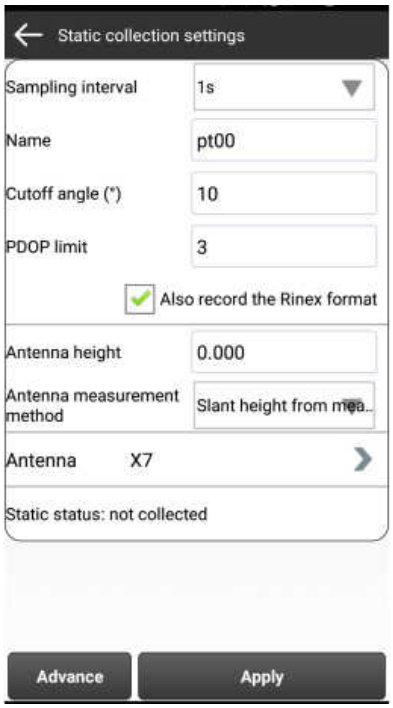


Figure 3-24

Figure 3-25

[Sampling Interval] The sampling interval is built-in and can only be selected via a drop-down list, with options including 1 second, 5 seconds, 10 seconds, 15 seconds, 30 seconds, and 60 seconds.

[Point Name] Only 4 digits and letters can be entered

[Static Altitude Angle] The altitude cut-off angle of the satellite during static acquisition, input range 5～30 degrees.

[PDOP Limit] Maximum limit of satellite PDOP for static acquisition.

[Instrument Slant Height] Input the slant height when setting up, the instrument recording static file is automatically calculated as the phase center height, and the input slant height can not be smaller than the radius of the receiver.

[Record Rinex Format at The Same Time] The Static measurement process is saved as a Rinex format file at the same time.

[Setup] Button sends the parameters to the receiver, the receiver working mode is

set to static mode, if the satellite meets the requirements that is to start the static acquisition, start the static acquisition when the [Setup] button changes to [Stop Acquisition], as in Figure 3-25, click on the [Stop Acquisition] to stop the static acquisition.

After the static mode is successfully set, the Static Settings button is checked

.

3.5 Data Debug

You can view the original NMEA data, communication instruction data, etc.

[Refresh] Real-time refresh of the currently received data.

[Clear] Clear the currently displayed data.

[Save] Save the currently displayed data as a txt file.

[Send] Send the contents of the send box to the receiver.

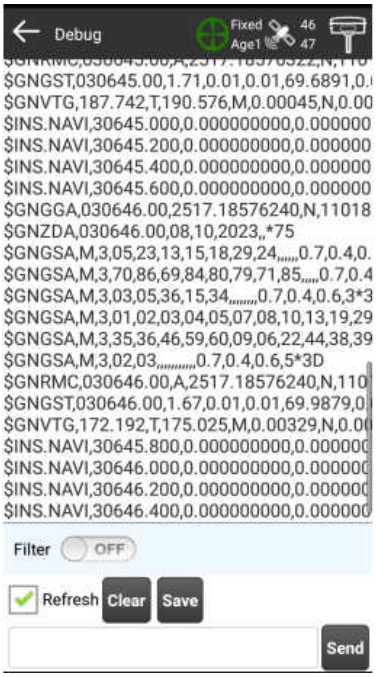


Figure 3-26

3.6 Analog Measurement

The handbook can simulate the measurement data in the simulation mode, which makes it easy for users to familiarize themselves with and learn how to use the software, as shown in Figure 3-27.

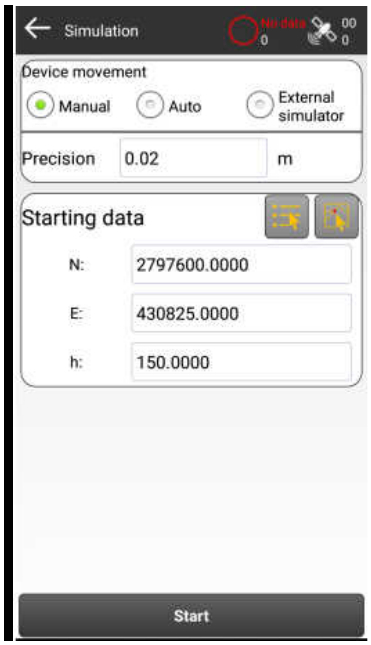


Figure 3-27

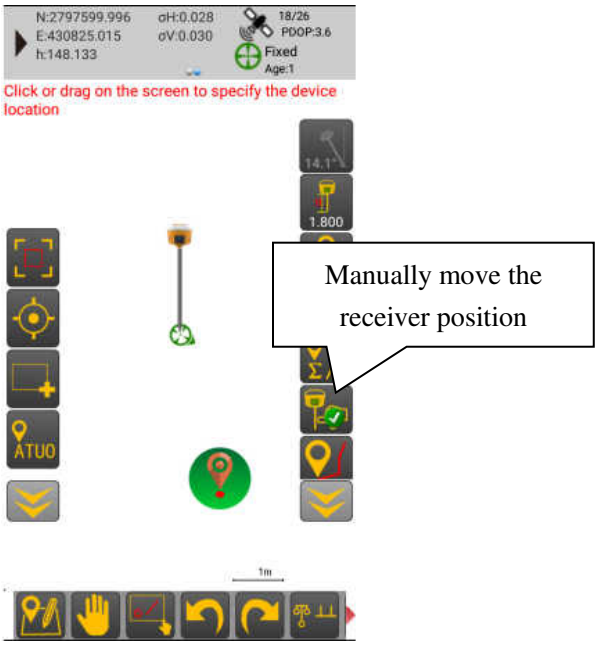


Figure 3-28

[Receiver Movement Method]

The way the mobile station position is moved in the simulation mode can be controlled manually, automatically, and by an external simulator.

Manual Move

In Manual Move mode, the graphical interface displays the button to move the receiver, as shown in Figure 3-28. When the Move button is checked, the receiver is moved by clicking on the screen or sliding with a single touch. The analog mode mainly uses the manual mode, which is more convenient for learning to use the drawing function.

Automatic Move

When you select the auto mode, you need to input the orientation of movement of the receiver, the receiver moves in one orientation at a set speed, if the orientation is selected as "Random", the position of the receiver jumps randomly.

Orientation: The orientation in which the receiver is moving.

Velocity: The speed at which the receiver moves, meters/second.

Accuracy: A random number is added to the receiver coordinate position.

Starting Data: Select Manual or Auto to simulate the initial position of the receiver when the measurement is turned on.

[Start] button turns on the analog mode.

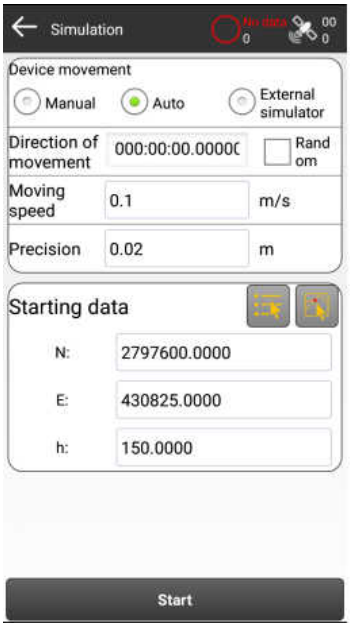


Figure 3-29

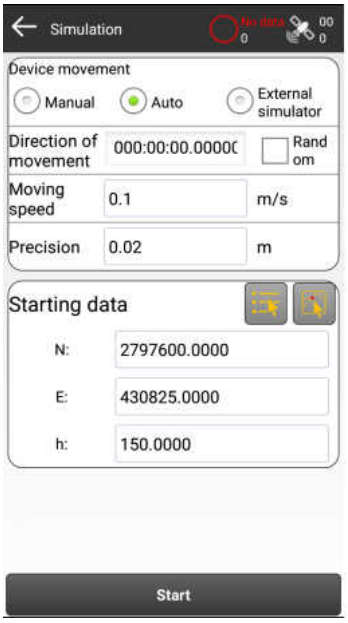


Figure 3-30

Note: You can't connect the instrument when you turn on the analog mode, you need to stop the analog measurement first, and you can't turn on the analog measurement when you have already connected the instrument, you need to disconnect it first.

External Simulator

External Simulator is a 3D simulation program for PC and Android. 3D Simulator provides a virtual 3D terrain environment containing various terrain features and allows you to walk freely with the receiver in the virtual environment.

Calling the external simulator requires the handbook to be connected to the computer via LAN (the computer needs to be connected to a LAN with the handbook, you can use a network cable or wireless connection).

As in Figure 3-30, when you select "external simulator" mode, enter the LAN IP address and port of the external simulator program and click Connect, after the connection is established, the simulator will send the coordinates of the receiver in the simulated environment to the handbook in real-time, so that you can carry out the

simulated measurement of topography and terrain through the 3D simulator, as in Figure 3-31.

Figure 3-31

3.7 Other Functions

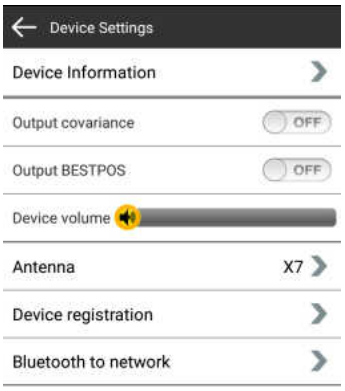


Figure 3-32 Figure 3-33

Instrument Information

Displays configuration information for the currently connected instrument, as in Figure 3-33.

Antenna Type Management

Antenna type management, mainly to set or select the corresponding instrument

type antenna for calculating the antenna height, as in Figure 3-34.

Radius (R): radius of the receiver;

Phase Deviation (L): the height from the phase center of the antenna (average of L1 and L2 phase centers) to the instrument height measurement scale line (bottom position of the lid).

Bottom to Height Measurement Scale (V): Height from the bottom (bottom of the connector) to the instrument height measurement scale.

Tips:

1. Some manufacturers of instruments with measuring height scale lines, then do not use the measuring height piece, at this time V and L are not 0, measure the slant height with a steel ruler to the scale line;

2. There is no marking line generally use the height measuring piece, at this time L is the distance from the phase center to the height measuring piece, V is 0, RTK measurements generally choose the height of the pole, measure the slant height with a steel ruler to the height measuring piece;

[Add] button can add custom antenna types, as in Figure 3-35, and the custom antennas that have been added can also be edited and deleted.

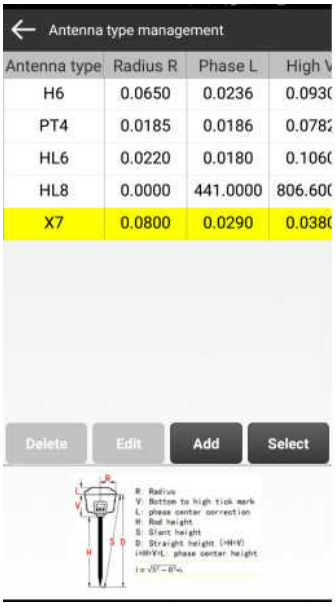


Figure 3-34

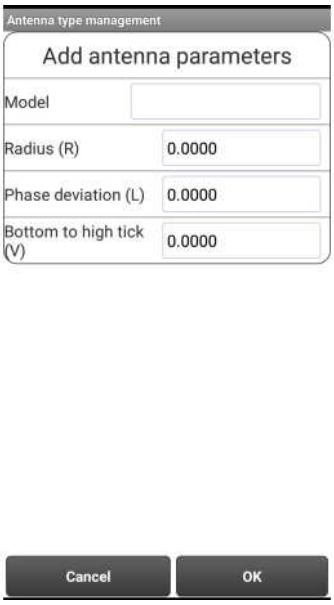


Figure 3-35

Figure 3-36

Select an antenna type and click [OK] to complete the antenna selection. The selected antenna parameters will be used to calculate the antenna height when measuring points.

Receiver Registration

Click the [Register] button to enter the registration interface, as shown in Figure 3-36, the registration type has a temporary registration code and a permanent registration code. If the temporary registration code, is the day before the expiration the receiver will voice prompt "registration code expires tomorrow" Users need to update the registration code.

Enter 20 digits of the registration code, including letters and numbers, and click [Register] to complete the registration.

3.8 Location Information Bar

In most screens there is a positioning information bar, as in Figure 3-37.

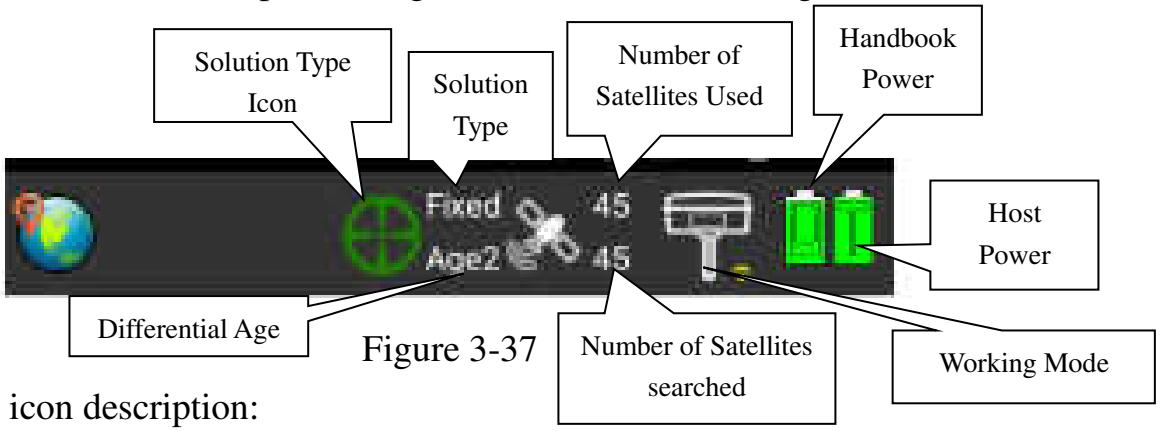


Figure 3-37

Solution type icon description:

: Fixed Solution; : Float Solution; : Code Difference;

: Single Point Solution; : Unlocalized

Working mode icon description:

: Mobile Station; : Base Station; : Static; : Total Station;

: Analog Measurement;

Solution Type: Accuracy from high to low is mainly divided into fixed solution, floating solution, code differential, single-point localization, and not localized.

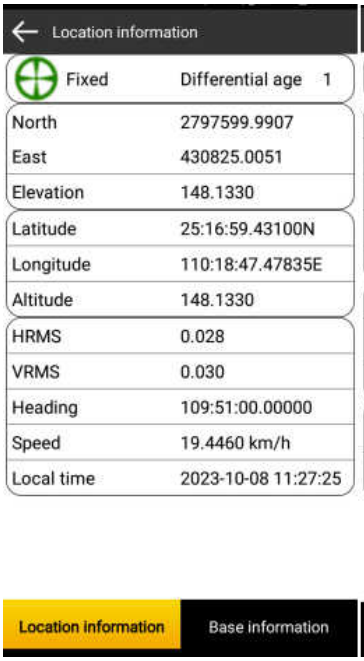
Differential Age: Differential data from the base station through the data link to

the mobile station for solving time, the smaller the differential age, the better, for 0 when no differential data is received.

PDOP: The spatial geometric intensity factor of satellite distribution, generally the better the satellite distribution, the smaller the PDOP value, generally less than 3 for the more ideal state.

Location Information

Click the "Solution Type" icon in the Location Information column to open the Location Information interface, as shown in Figure 3-38.



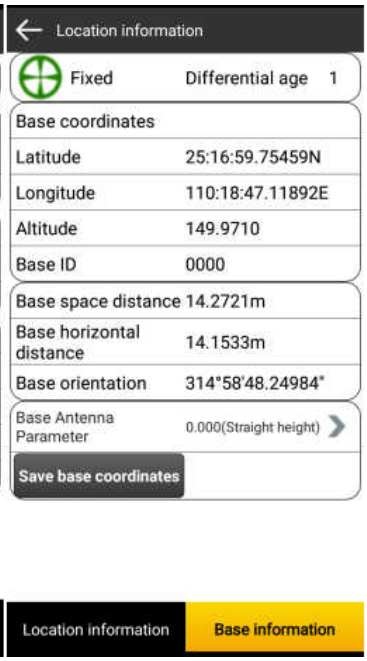


Figure 3-38 Figure 3-39

Displays the position information of the current point, including coordinates, speed, solution status, time, and other information.

HRMS: Horizontal positioning accuracy

VRMS: Vertical positioning accuracy

Azimuth: Azimuth of receiver movement

Velocity: Speed of receiver movement

Time: Local time (you can set the current time zone in the project, the default is East 8)

When the mobile station receives the base station coordinates, it can display the base station coordinates, as in Figure 3-39, and the base station azimuth is the azimuth from the current point to the base station.

[Save Base Station Coordinates] Can save the base station coordinates to the control point library.

Satellite Information

Click on the "Satellite" icon in the Positioning Information column to open the Satellite Information interface, as shown in Figure 3-40.

Star Map

You can view the distribution of satellite projection positions, different icons represent different satellites.

Multi-select box can choose whether to display (not disabled or enabled) GPS, BD, GLONASS, or SBAS satellites, the corresponding number under the multi-select box is the number of locked satellites.

Set the color of the satellite number according to the L1 carrier SNR of the satellite: Gray<=15, 15<Red=<25, 25<Yellow=<35, 35<Yellow=<35. 25<yellow=<35, 35<yellow-green=<45, green>45.

Satellite Information：

L1 indicates the L1-band signal-to-noise ratio and L2 indicates the L2-band signal-to-noise ratio, as shown in Figure 3-41, where different colors in the table indicate different satellite types.

The signal-to-noise ratio is a measure of satellite signal strength. The range is from 0 to 99, where 99 is the best, 0 means the satellite is not available, and a typical good value is 40.

DOP (Depth of Precision Factor)

A quality marker for GNSS positions, the smaller the DOP value, the more reliable the accuracy.

PDOP: Position (Three-Dimensional Coordinates), the spatial geometric intensity factor of the satellite distribution, generally the better the satellite distribution, the smaller the PDOP value, generally less than 3 for the more ideal state.

HDOP: Horizontal (Two-Dimensional Horizontal Coordinates).

VDOP: Vertical (Height).

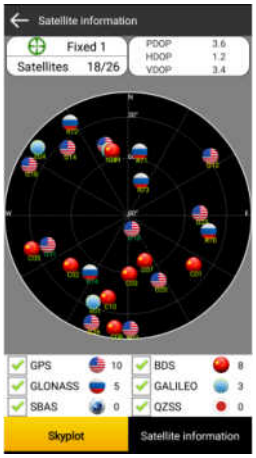


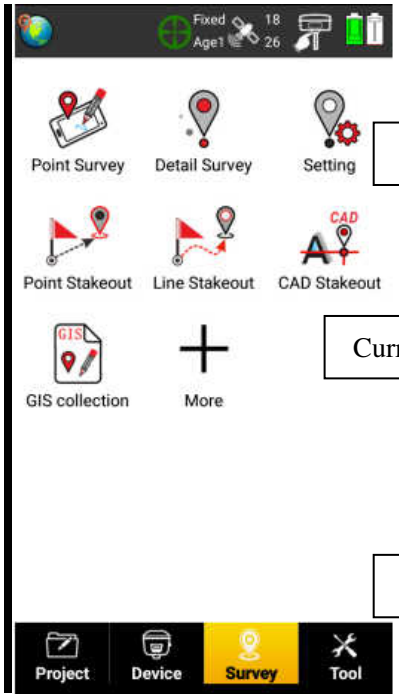
Figure 3-40

Figure 3-41

Chapter IV. Survey and Plot

4.1 Graphical Interface Introduction

As in Figure 4-1 Click [Survey and Plot] on the Measurement page to enter the graphical interface, as in Figure 4-2.



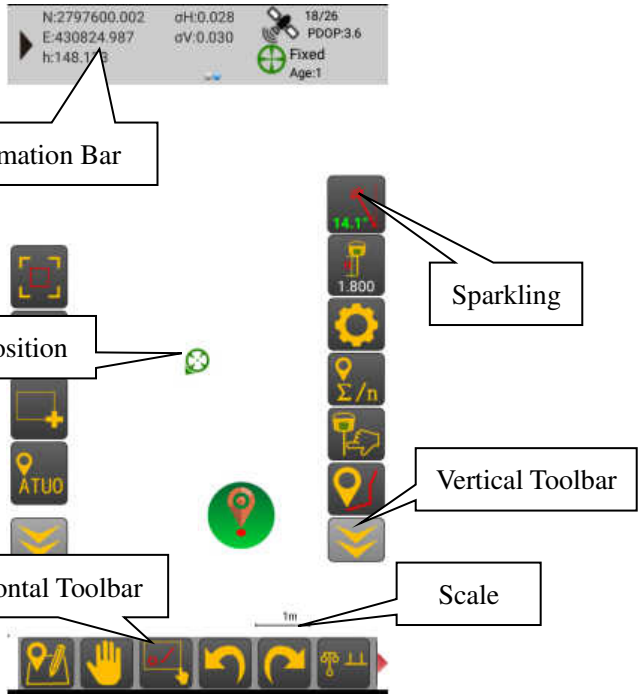


Figure 4-1 Figure 4-2

The current receiver position is symbolized by , the arrow indicating the direction of walking movement and the center of the circle indicates the point.

[Top Information Bar]

As shown in Figure 4-3 and Figure 4-4, it is divided into two pages, swiping left and right to switch the page, and clicking the Hide Expand icon on the left side to hide and show the information page.

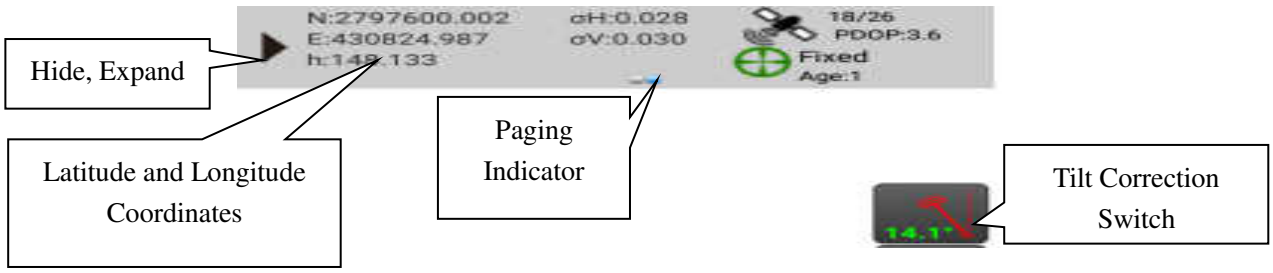


Figure 4-3

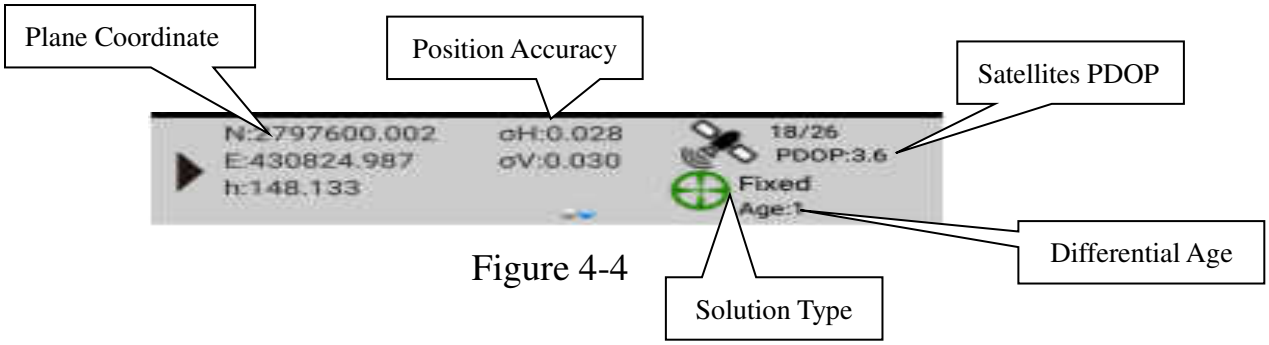


Figure 4-4

[Vertical Toolbar]

Calculate Polyline Points; Frame Zoom; Full Map View; Center Current Point; Smooth Acquisition; Other Collection Point Methods; Automatic Record; Measure Points and Connect Lines; Point Acquisition; Hide, Expand;

[Horizontal Toolbar]

Open Plot Toolbar; Pan Graph; Select Graphical Element; Withdrawn; Redo; Symbol Library; The Most Recently Used Symbol; Setup; Save Graphic; Color Setup; Layer Setup; Baidu Map; Compass Display; Help;

Note: The effect of clicking and long-pressing the center button is different when the current point is centered. The scale of the centered display remains unchanged when you click it, and the centered display is automatically scaled to the appropriate scale when you long-press it.

[Plot Toolbar]

Click the Draw button on the Horizontal toolbar to open the Display Plot toolbar, as shown in Figure 4-5.

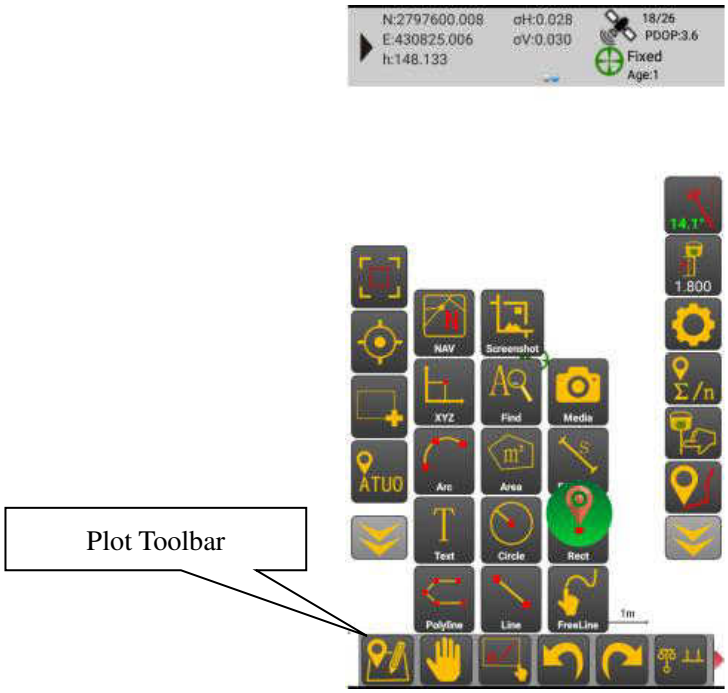
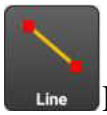


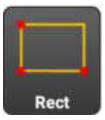
Figure 4-5

Plot Polyline; 

Plot Straight Line;

Plot Hand Drawn Line;

Plot Circle;

Plot Text; 

Plot Quads;

Photograph, Videotape, Record;

Measure Distance and Azimuth;

Query Coordinates;

Measure Area;

Plot Arcs;

Graphic Screenshot;

Find Text;

4.2 Plot Function

Plot Tips

In the upper left corner of the measurement and plotting interface, the red font is "Plot Tips", when you select different plotting commands, you will be prompted how to plot and the current plotting commands, and so on.

Graphics Zoom and Pan

Graphics zoom and pan operation: two touch points on the screen to slide to zoom the graphics, move two touch points at the same time to move the graphics.

Magnifying Glass

As shown in Figure 4-6, the magnifying glass is in the upper left corner of the screen, when the touch screen slides drawing, displaying a magnified image of the current touch point, you can use the magnifying glass to view the graphic below the finger, using the touch drawing is convenient to see whether the object is captured.

[Pan]

A single touch on the screen pans the graphic, and two touches can pan and zoom at the same time.

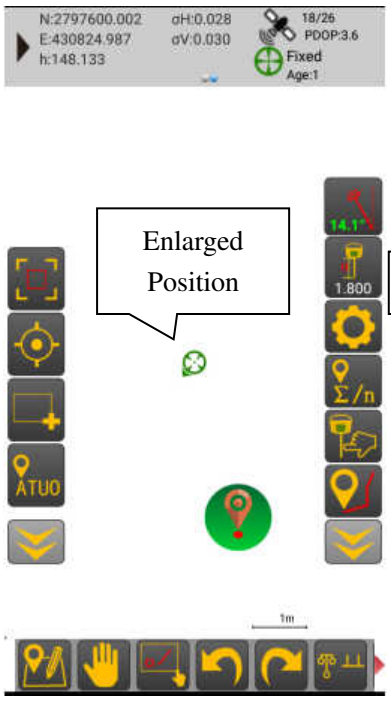


Figure 4-6

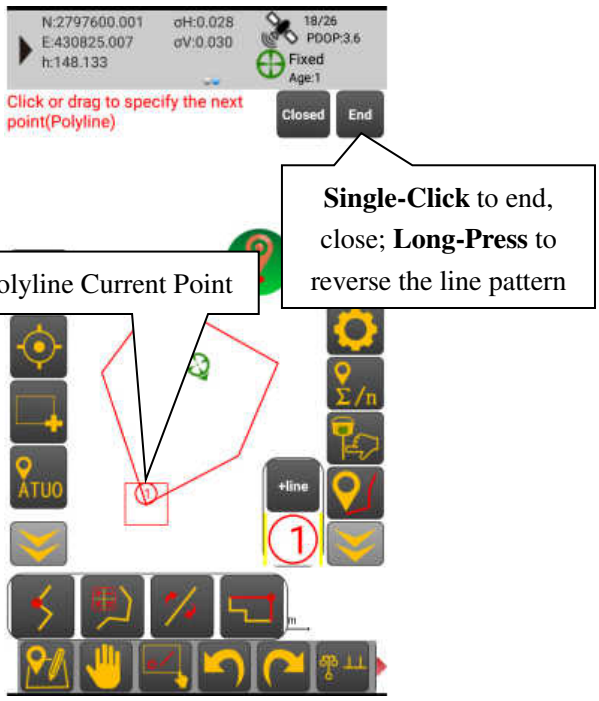


Figure 4-7

4.2.1 Plot Toolbar

Click the "Plot" button on the bottom toolbar to open the plotting toolbar, which includes polyline, straight line, hand-drawn line, circle, text, quadrilateral, area, arc, ingest, distance, coordinate check, screenshot, and text search. After selecting the Plot button, the " Plot Tips" at the top of the toolbar will indicate how to complete the plotting and the current plotting instructions accordingly.

4.2.1.1 Polyline

Click the “Polyline” button, and the "Plot Tip" is: "Click or drag to specify the first point (polyline)", and the current plotting instruction is in parentheses. Click on the screen and plot the first point when the touch pops up. The currently plotted point has the "polyline" label displayed, as shown in Figure 4-7, click on the screen to plot the second point, and draw each point of the polyline in turn. Single-point touch on the screen when clicking or swiping can be realized when the object is captured. When the

touch point and the diagram of the existing polyline endpoints, nodes, etc., the distance is less than the set screen units can be captured to the point. After successful capture will appear capture prompt box, and you can view the magnifying glass to complete the object capture.

Tips: The polyline selected in the Plot Toolbar is a non-attributed polyline, equivalent to a PL line in CAD, and the polyline selected in the Symbol Library is an attributed polyline.

Plot Polyline Techniques:

1. Plotting a polyline process can be a two-point touch screen on the graphic zoom panning operation, in order to draw more areas outside the screen, zoom panning after the end of a single touch to continue to draw;

2. The need to end the current polyline, click the upper right corner of the screen [Close] or [End] button, long press [Close] or [End] can end the polyline and at the same time, the line type change direction (there are attributes of the polyline such as: can, slopes have a line type of polyline, often need to carry out the line type change direction);

3. Plotting a polyline process click the [Undo], and [Redo] buttons, you can undo the drawing of the point, or redo the undo point;

4. Plotting a polyline, if two points at the same time touch the screen, the finger pops up when the current point will not be drawn to facilitate the scaling and plotting of the interactive process.

5. Plotting a polyline is not yet finished when you can switch to other plotting commands, after the end of the other commands, to continue to plot the polyline, just click the [polyline] button to continue plotting.

Calculate Polyline Points

The auxiliary toolbar can be displayed at the bottom when a polyline is being drawn on the graph, as in Figure 4-7-2, and you can determine the location of the next polyline point or edit the last point by parameter calculation. Calculate the polyline point according to the deflection angle, azimuth angle, and length, as in Figure 4-7-1.

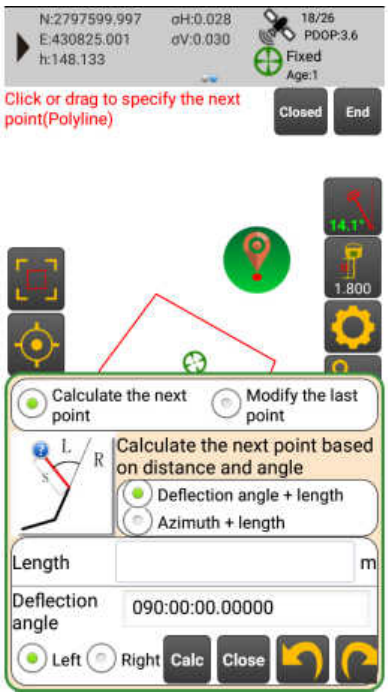


Figure 4-7-1

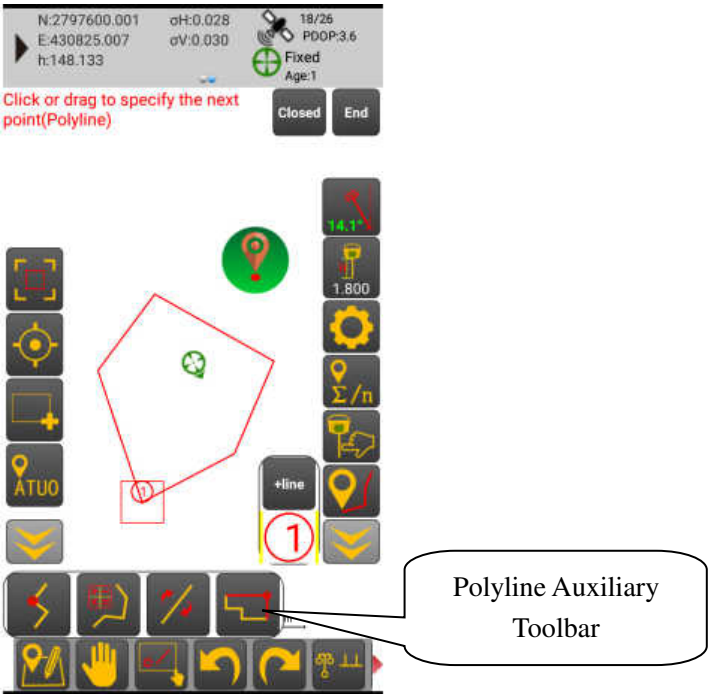


Figure 4-7-2

Measuring features such as houses allows you to calculate the next point position by entering the deflection angle (default 90 degrees) and distance. Modify the coordinates of the last polyline point by azimuth and distance.

Polyline Corner

If the polyline has been plotted with at least two points, the Corner Points button is displayed and can be plotted at right angles one point apart, as in Figure 4-7-3.

Multi-Segment Line Commutation Plotting

During the plotting of the polyline, you can switch to the starting point of the line by clicking on the switching button "Turnaround Plot".

Partition closure

Clicking on the Interval Closure button automatically inserts a right-angle point of inflection for closure. For example, when measuring a four-point square house you can plot to the third point and click on Interval Closure to automatically calculate the fourth right angle point.

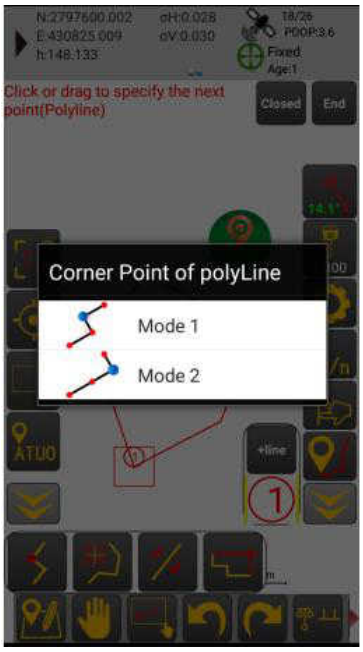


Figure 4-7-3

4.2.1.2 Straightness

Click on two points on the screen to plot a line (imported into CAD as a "Line" type instead of a polyline).

4.2.1.3 Hand- Drawn Line

The hand-drawn line is a sliding trajectory that draws the touch point, and the drawing is completed when the touch point pops up. If two points touch the screen during drawing, the current hand-drawn line will be canceled. Object snapping is not available for drawing hand-drawn lines.

Hand-drawn lines are used as auxiliary lines for drawing graphics, generally used for electronic sketching, quick notation, and drawing graphics, as a schematic diagram. Hand-drawn lines exported to the dxf file with CAD to open are actually a polyline, stored in the "hand-drawn lines" layer, in the drawing of the completion of the hand-drawn lines can choose to delete the entire layer.

4.2.1.4 Circle

Provides three ways to draw a circle, as shown in Figure 4-8:

Two points to draw a circle: specify the center and radius on the screen to draw a circle;

Three-point circle drawing: specify three points on the screen and draw a circle passing through these three points; the three points cannot share the same line and any two points cannot be the same;

Center plus radius: specify the center of the circle on the screen and manually enter the radius to draw the circle.

4.2.1.5 Text

Click on the "Text" button, then will be prompted to click or drag the screen to specify the text insertion point, click on the screen to determine the insertion point after the pop-up Add Text form, Figure 4-9, the corresponding text that is inserted into the figure on the specified point location, such as Figure 4-10.

Enter the text content, and font height (unit: meters), and click [OK] to insert the text.

[Add to font] Frequently used text can be saved to the font for quick and easy insertion of text. Click OK after checking the box to save it to the font. Enter the Add Text form and click the content of the font directly to insert text. The order of the text in the font will be sorted according to the frequency of use, and the most used text will be on the top. Long-press the text in the font to delete it.

[Empty the font] Can clear all the text in the font.

[Note type] Add note type to the text, different notes where the text layer is different, and the color is also different, including the following note types:

"Geomorphology and Soil", "Vegetation", "Industrial and Mineral Buildings", "Transportation Facilities", "Pipeline Facilities", "Water Facilities", "Residential Land", "Boundary", "Control Points", and "Others".

The respective corresponding layers are named:

"DMTZ", "ZBTZ", "DLDW", "DLSS", "GXYZ", "SXSS", "JMD", "JJ", "KZD", "0".

In addition to the "Other" type of text without attributes, the rest of the type of text with attributes, with attributes of the text can be queried in CASS, and the text

color with the layer can not be modified.

Note: If you need to set the text color, you can only select the "Other" type of note and choose the color in the drawing color!

[Hide, Expand] buttons to hide and show note types.

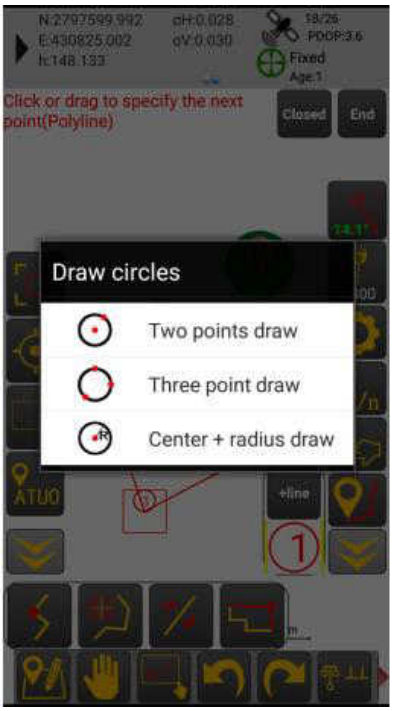


Figure 4-8

Figure 4-9

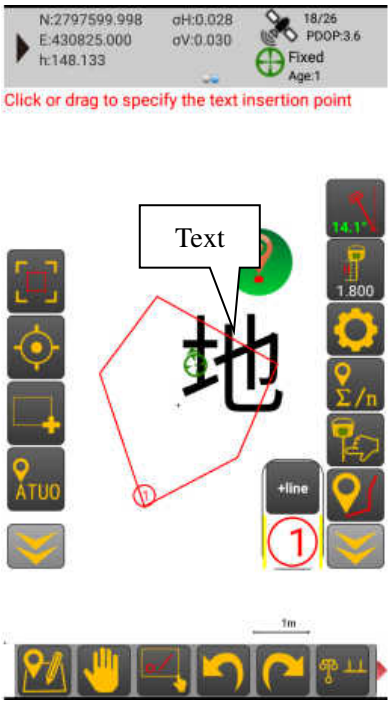


Figure 4-10

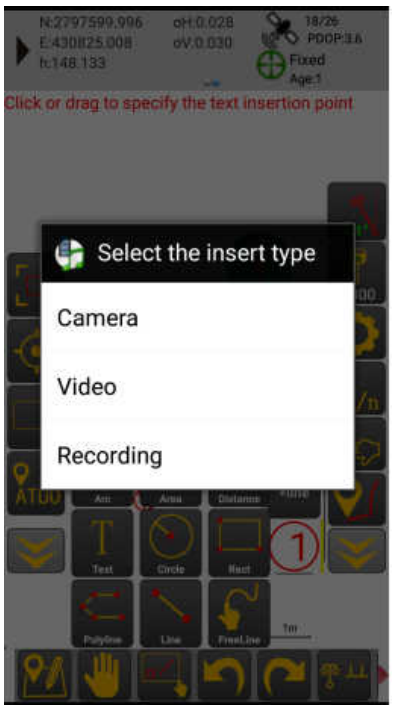
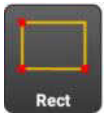


Figure 4-11

4.2.1.6 Quads 

There are 5 ways to draw a quadrilateral (closed polyline):

1. Three points to draw a parallelogram

As in Figure 4-11-1, click on the figure to draw three points, and the program automatically determines the fourth point to generate a parallelogram.

2. Two points + width to draw a rectangle

First, click on the figure to draw 2 points to determine the length of the quadrilateral, and then pop-up dialog box as in Figure 4-11-2, enter the width and direction (the first point to the second point of the line to the left or right) to generate a rectangle.

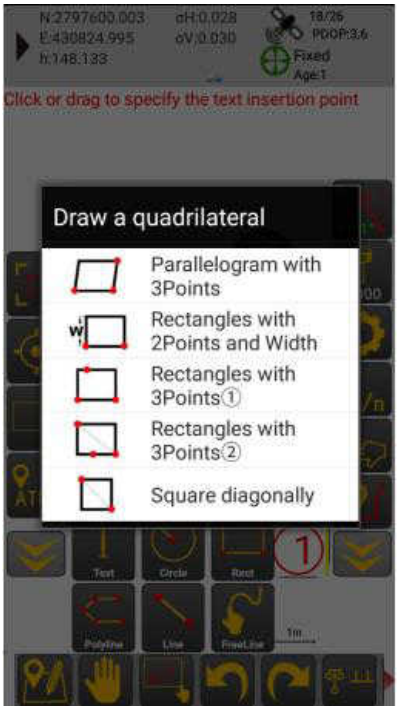


Figure 4-11-1

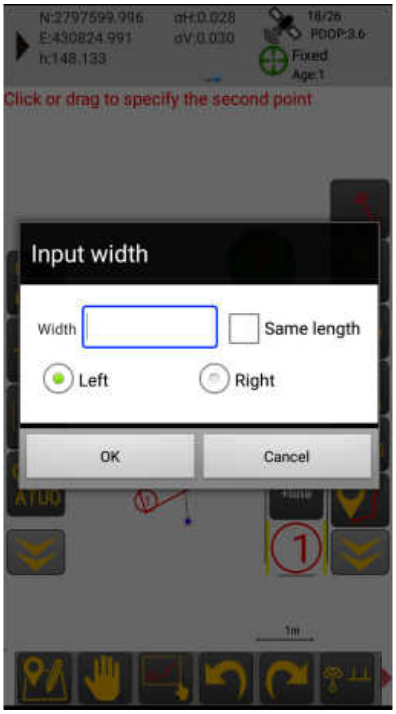


Figure 4-11-2

3. Drawing Rectangles with Three Points①

As in Figure 4-11-3, the order of drawing points is A-B-C. Points A and B determine the length of the rectangle, and point C determines the width of the rectangle, which is categorized into two scenarios, [Situation 1]: point C is projected within the range of AB; and [Situation 2]: point C is not projected within the range of AB.

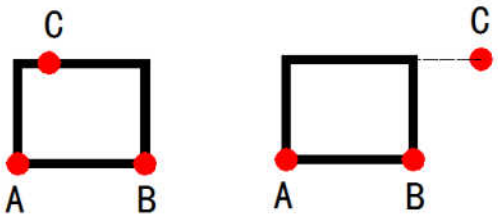


Figure 4-11-3

4. Drawing Rectangles with Three Points②

As in Figure 4-11-4, the order of drawing points is A-B-C. Points A and B determine the direction of the rectangle, and points A and C determine the diagonal of the rectangle, which is divided into two cases, [Case 1]: point C is projected in the direction of AB; [Case 2]: point C is projected in the opposite direction of AB.

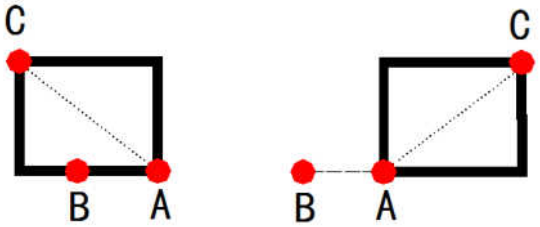


Figure 4-11-4

5. Drawing squares diagonally

Two points determine the diagonal of the square to draw the square.

4.2.1.7 Circular Arc

Determine three points on the screen to draw an arc.

4.2.1.8 Videotape

Recording includes camera, audio and video. Click the " Videotape " button, this time the dialog box will pop up to select the type of insertion, such as Figure 4-11.

Camera: Click the "Camera" option, prompted to click or drag the insertion point of the specified photo on the screen, the camera form will pop up, and after the completion of the photo will be drawn at the insertion point of a photo icon

Recording: Click the "Add Recording" option, prompted to click or drag the insertion point of the specified recording on the screen, and the recording form will pop up, such as in Figure 4-12, click Start Recording, record into the microphone,

click Stop Recording when you are done, and then a recording icon will be drawn at the insertion point.

Video: Click the "Add Video" option, prompted to click or drag the insertion point of the specified video on the screen, the pop-up video form, such as Figure 4-13, click the video icon, and then click the video icon to stop video recording, in the insertion point to draw a video icon, such as Figure 4-14.

Click the photo, audio, and video icons on the diagram in pickup mode to open the picture and play the audio and video recordings. The files are saved in the media file under the project folder.

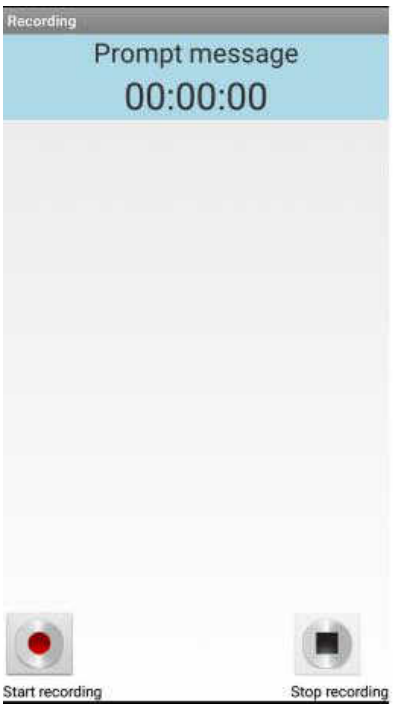


Figure 4-12

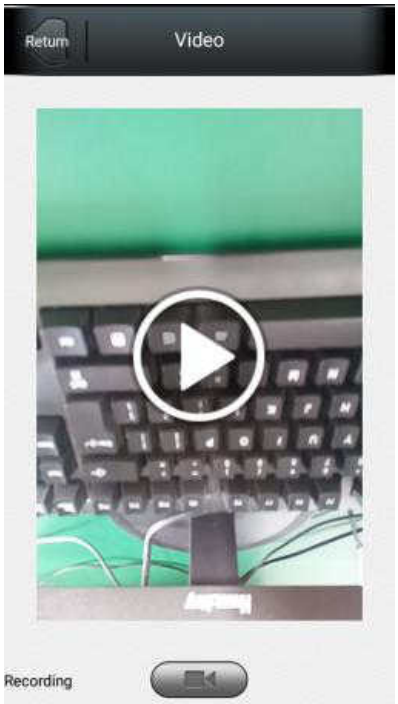


Figure 4-13

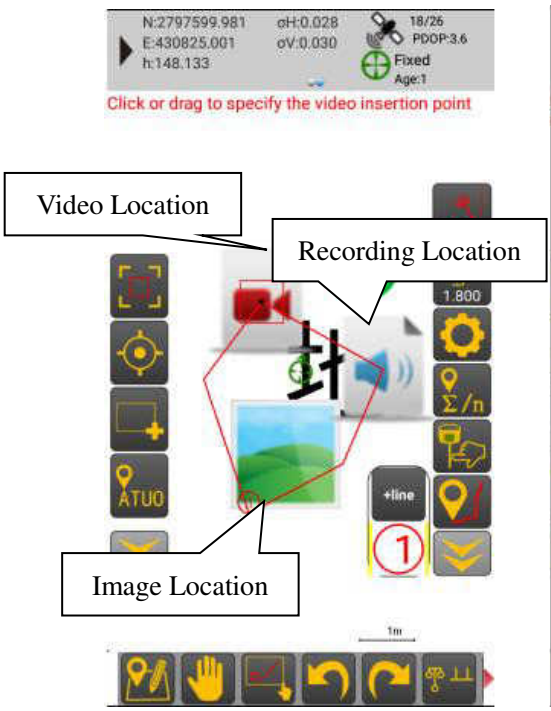


Figure 4-14

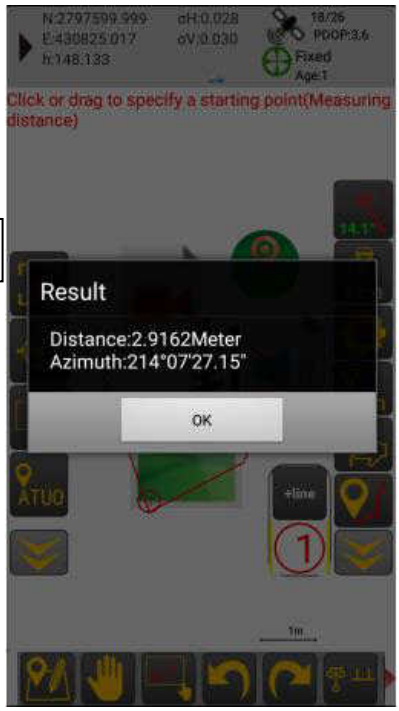


Figure 4-15

4.2.1.9 Gauge

You can measure distance and azimuth by clicking two points on the graph, as in Figure 4-15.

4.2.1.10 Query Coordinates

Click or drag to query the coordinates of the specified point, the object capture can capture measurement points, graphics, etc., if it is not the point of the coordinate point library is a temporary point, and the temporary point elevation is 0. As in Figure 4-16, you can save the coordinate point of the measurement point library.

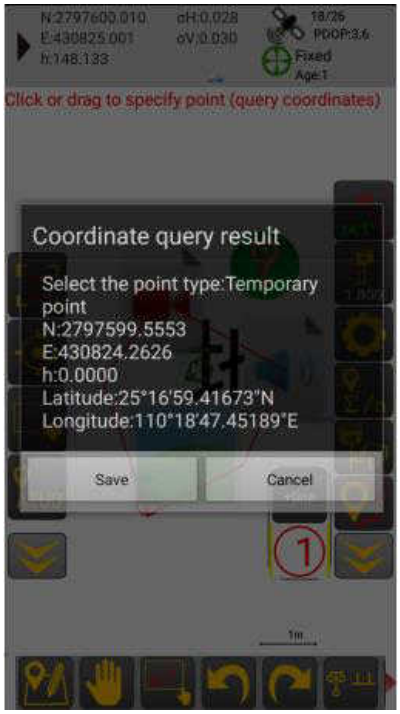


Figure 4-16

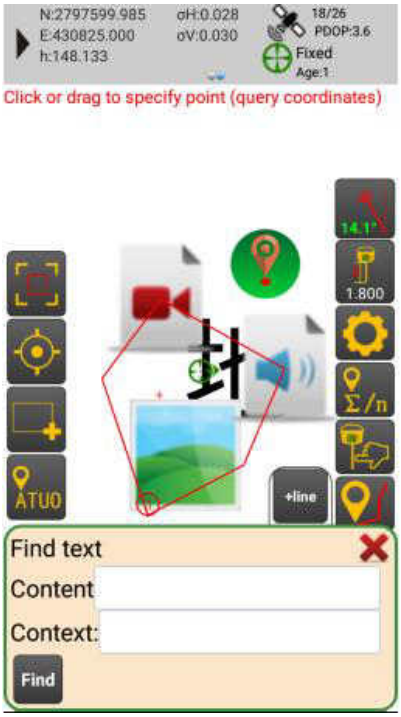


Figure 4-16-1

4.2.1.11 Screenshot

Saves the graphics within the current screen to JPG image format.

4.2.1.12 Query Text

Search for matching text within the graphic, as in Figure 4-16-1, as long as the text contains the query character will be found, case-sensitive letters. Click [Find Next] when there is more than one matching text, the graphic is automatically zoomed to the target text position, and the context indicates the complete content of the found text.

4.2.2 Drawing Symbol Library

[Symbol] Open the drawing symbol library, such as Figure 4-17, the symbol library includes a variety of topographic maps commonly used symbols, symbols to select the menu structure of the form, and CASS7.0 similar to the nine categories: vegetation and gardens, geomorphology and soil, boundary lines, water

facilities, pipeline facilities, transportation facilities, independent features, residential areas, control points.

Click on the first level menu item to expand the second level menu, such as Figure 4-18, vegetation garden contains arable land, garden land, woodland, grassland, other vegetation, land class fire prevention second level menu. Click on the second-level menu item to enter the symbol menu, for example, click on "Cultivated land" to enter the cultivated land symbol interface, such as Figure 4-19.

The symbol library contains two types of symbols: polylines and reference blocks (dot symbols). The symbols selected in the Symbol Library are all attributed (with CASS 7.0 attribute codes, line widths, and layer information).

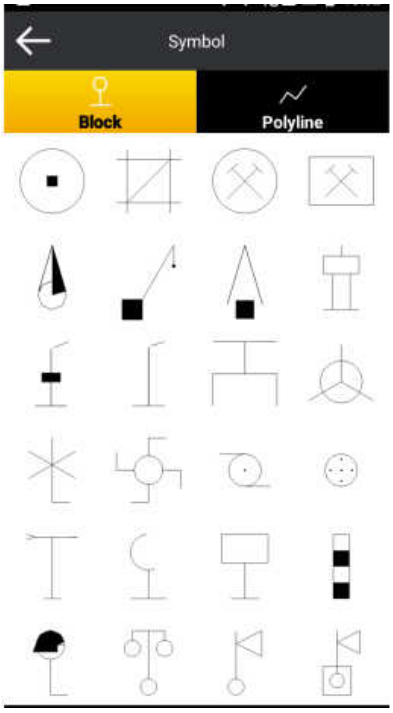


Figure 4-17

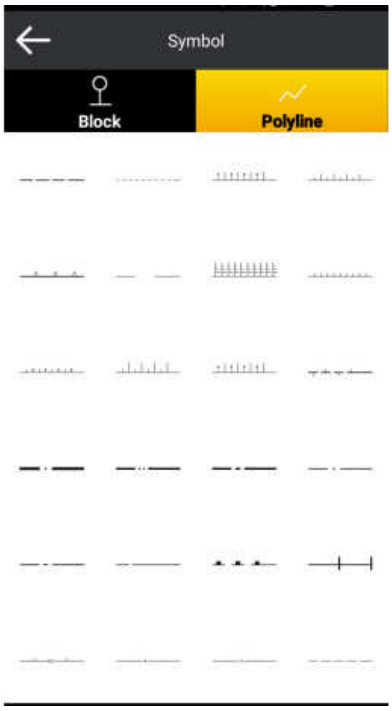


Figure 4-18

Click on an item in the Symbols menu, if you select a polyline type, draw the graph according to the polyline, if you select a reference block, click on the screen to insert a point symbol.

Polyline: If the selected symbol type is a polyline, the program will automatically switch to the mode of drawing polyline, and the drawn polyline will be with attributes, and the polyline drawn by using the line measurement function at this time is also with attributes.

Note: When you use the attributed polyline in the symbol library for the line measurement process, switch to other non-polyline drawing commands, and after the completion of the other commands, you can click on the [Polyline] button on the drawing toolbar to continue to draw, or re-select the symbol in the symbol library.

Reference Block: The reference block is CAD inside the "block reference", each reference block represents an independent symbol, these reference blocks and the CASS7.0 symbol library are consistent, and the reference block is divided into two types:

1. Do not rotate the point-like features, such as Figure 4-20 of the street lamp, specify an insertion point on the screen to draw the symbol.

2. Rotating point features, such as Figure 4-20 of the wire into the ground. Specify two points on the screen to draw the symbol, the first point is to specify the insertion location, the second point is to determine the direction of the symbol, and specify the direction of the touch screen slide, the symbols are displayed in real time, pop up and touch the specified direction to complete the drawing.

Note: The program defaults to the last command, you can continuously repeat the drawing of multiple symbols.

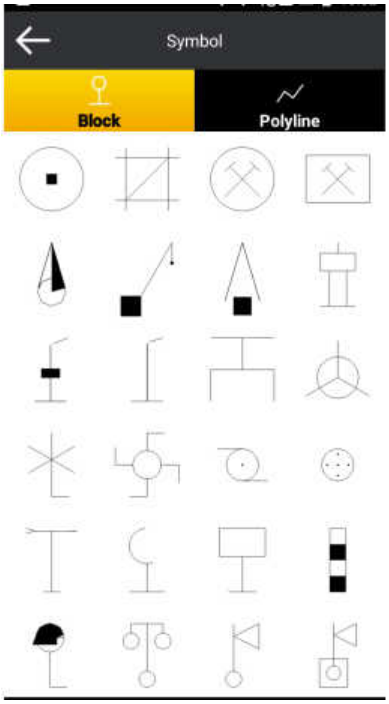


Figure 4-19

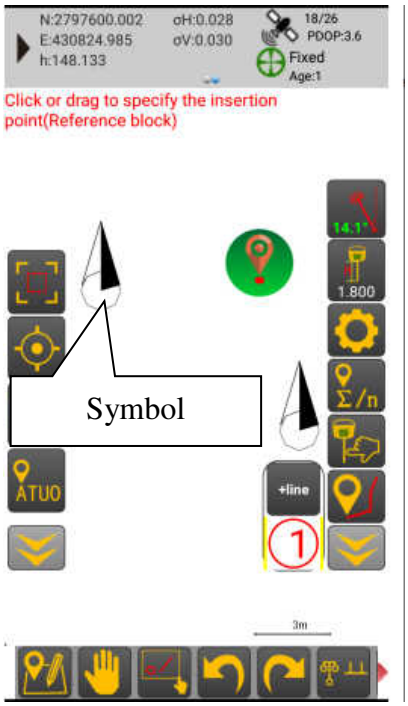


Figure 4-20

[Recently used symbols]

The software automatically saves the used symbols to the Recent Symbol Library, which is convenient for quick selection of symbols, as shown in Figure 4-21, the symbols inside the Recent Symbol Library will be sorted according to the frequency of use, and the symbols that are used frequently will be in the front, and the Recent Symbol Library will save up to 25 symbols, and the least frequently used symbols will be eliminated if they are larger than 25.

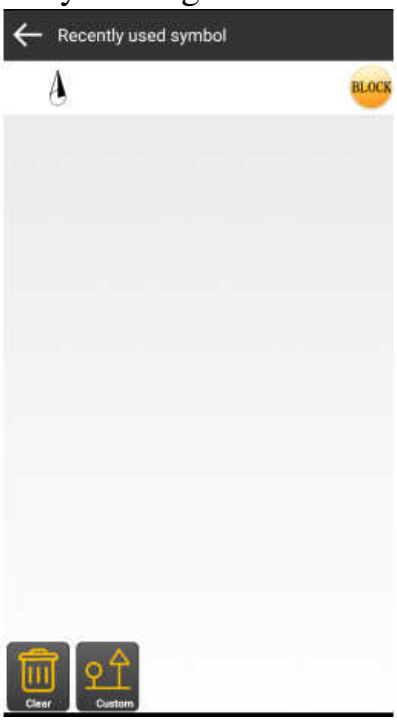


Figure 4-21

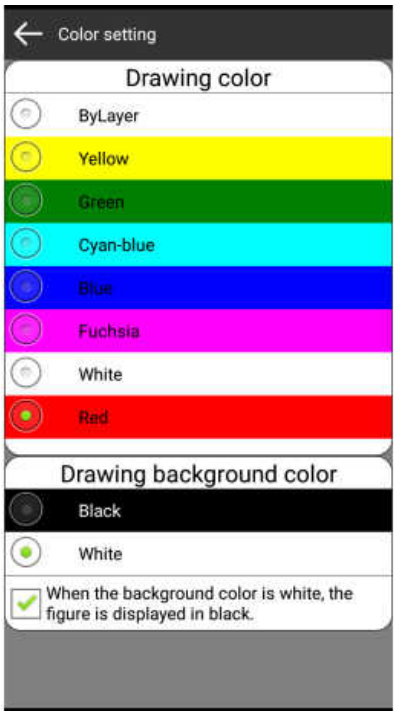


Figure 4-22

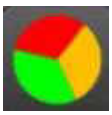
Long press a symbol in the list to delete it, click the [Empty] button to empty the recently used symbols, and click the [Symbol] button to enter the total symbol library.

Note: The drawn symbols and polylines are exported to a dxf file and opened with CASS, you can query the attributes of the symbols, and the line types and layers of these elements are consistent with those of CASS.

[Save]

The current graph is saved manually, the saved file name is the same as the current project name with a .gsc suffix, the graph is saved separately from the measured points, and each time a fragment point is collected it is automatically saved to the point library.

4.2.3 Color and Layer Settings

[Color] 

As shown in Figure 4-22, the color set here is the color of the non-attribute element, the polyline, straight line, hand-drawn line, circle, and text (note type select "Other") selected through the drawing toolbar are non-attribute elements.

Color types include Layer, Yellow, Green, Cyan, Blue, Fuchsia, White, and Red.

With layers: The color of the element uses the color of the layer on which it is drawn. Elements drawn in the drawing toolbar (without attributes) are on layer "0" (hand-drawn lines are on the "Hand-drawn lines" layer) and the layer color is black/white. It is recommended to use the layer color for drawing non-attributed elements. The advantage of using the layer color is that when you use the "Brush Attribute" function in CASS to brush a non-attributed element to an attributed one, the color of the element being brushed will be the same as the color of the layer it is on. If you use a color that is not the color of the layer you are drawing on, the color will remain the current color when you brush the attribute.

White: Displayed as white when the background color is black, or black when the background color is white.

Note: The color of the attributed polyline and reference block selected inside the symbol library is the default (with the layer color) and cannot be modified, the color set here does not work for attributed elements.

Drawing Background Color: Set the background color of the drawing area, only black and white can be set, generally set to white in the field environment is easy to see, black background as in Figure 4-23.

When the background color is white, the drawing will be displayed in black: When checked, it means that when the background color is white, all the elements will be displayed in black, which is easier to see under the sunlight (some colors, such as yellow, are not obvious under the white background).

Figure 4-23

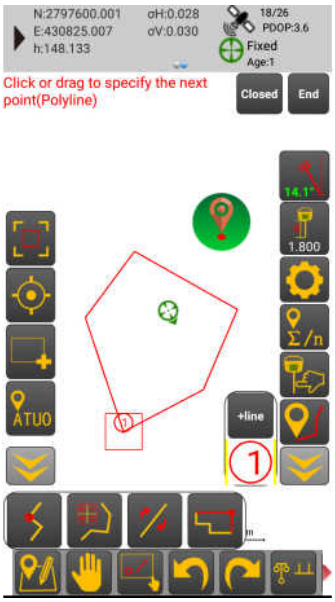


Figure 4-24

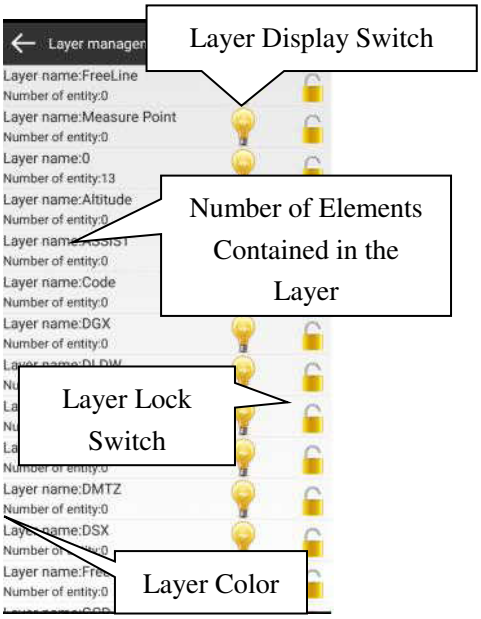


Figure 4-25

[Layer Management]

Open the Layer Manager, as in Figure 4-25. Each element belongs to a layer. The elements drawn by the drawing toolbar are stored in the "0" layer, except for the "hand-drawn lines" stored in the "hand-drawn lines" layer. Measurement points are stored in the "Measurement points" layer. Layers with attribute elements are CASS standard layers.

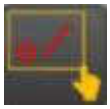
You can see the color of the layer and the number of elements it contains in the Layer Manager.

Close Layer: Click on the "bulb" icon to close the layer, after closing the layer, the elements of the layer will not be displayed on the map.

Lock Layer: Click the "Lock" icon to lock the layer, after locking, you can not pick up the elements of the layer.

Note: 1. The color of the layer can not be modified, the color of the attribute elements and the color of the layer to which they belong is the same.

4.2.4 Graphics Editor

[Pick Up] 

Picking up of graphical elements is done using the box selection or clicking method, and clicking the [Pickup] button switches to the pickup mode. Click and drag on the screen, with the movement of the touch point real-time display pickup box.

1. Box selection: divided into two kinds of box selection and box cross:

Box Selection: Draw a rectangle (solid line) from left to right, the pixel that is completely contained by the rectangle will be selected, such as in Figure 4-26.

Box Intersection: draw a rectangle from right to left (dotted line), the rectangle is contained and intersected by the pixel that will be selected, such as Figure 4-27.

The selected tuples are displayed with dotted lines and blue dot markers at the nodes, as in Figure 4-28 ultiple selection is supported, so you can box multiple tuples on the screen consecutively. Click [Undo] or click [End] in the upper right corner to cancel the picking when the graph element is selected.

2. Click to Select: directly click on the map element to select.

Note: You can't pick up the measurement points, sample points, and control points in the picking mode, the point data are important data, which form the basis of mapping, in order to prevent picking up and deleting the measurement points by mistake in the process of mapping, the mapping interface can't pick up the data of these points, and the points that have already been measured can't be withdrawn from the measurement points by the Undo button. If you want to pick up and delete the measurement point data, you can do it in the coordinate point library.

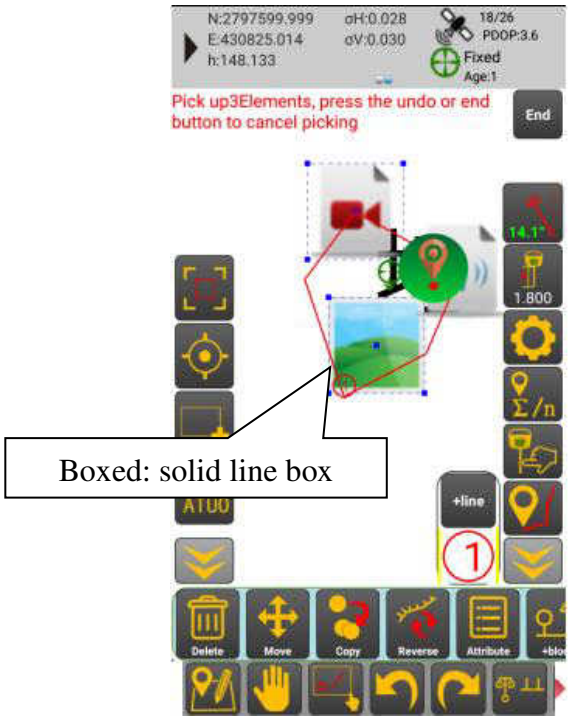


Figure 4-26

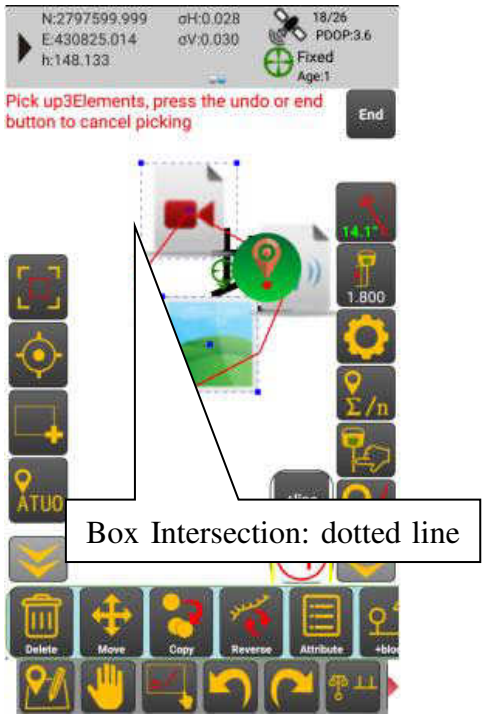


Figure 4-27

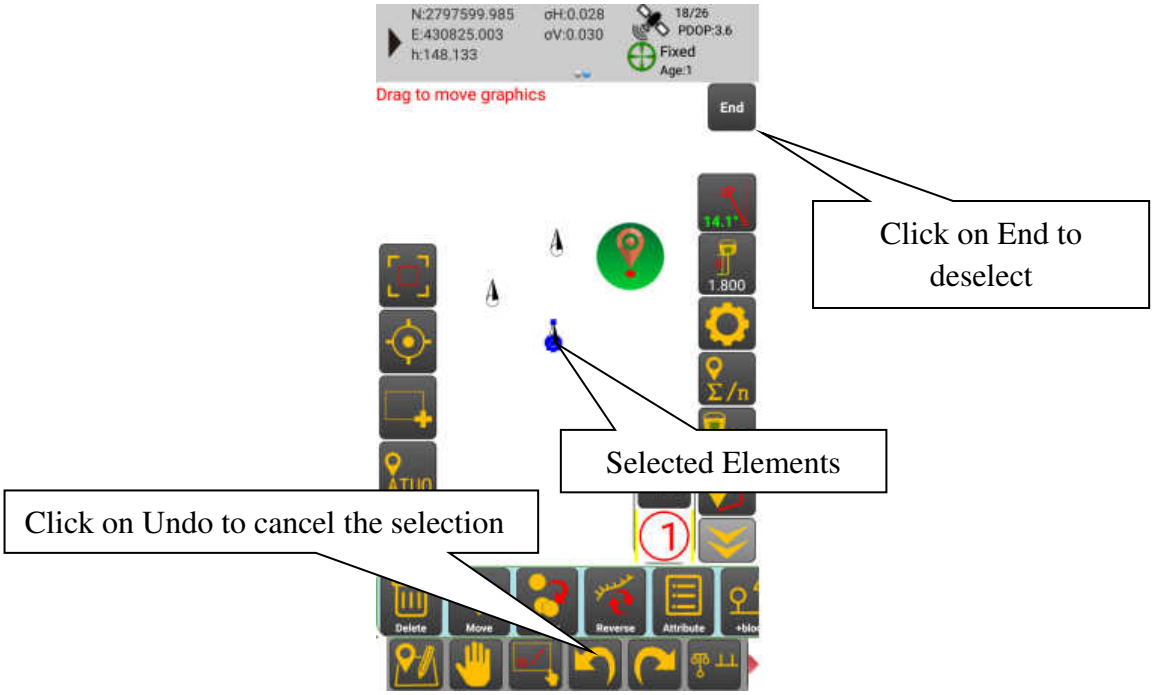


Figure 4-28

When there is an element selected, the editing toolbar will pop up, as in Figure 4-29. The editing toolbar includes: Delete, Move, Copy, Line Reversal, Offset, Query Properties, and Modify Text.

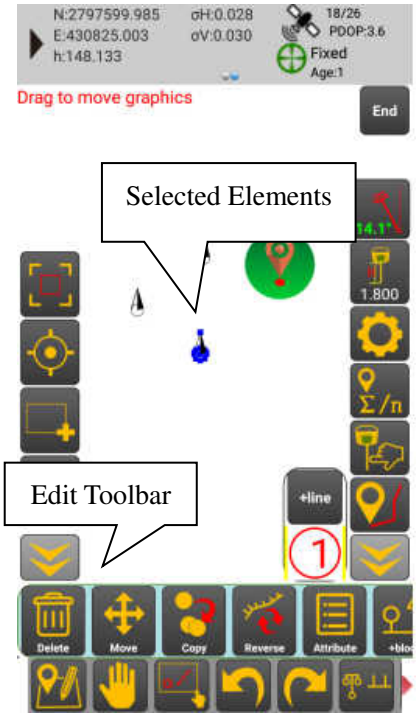


Figure 4-29

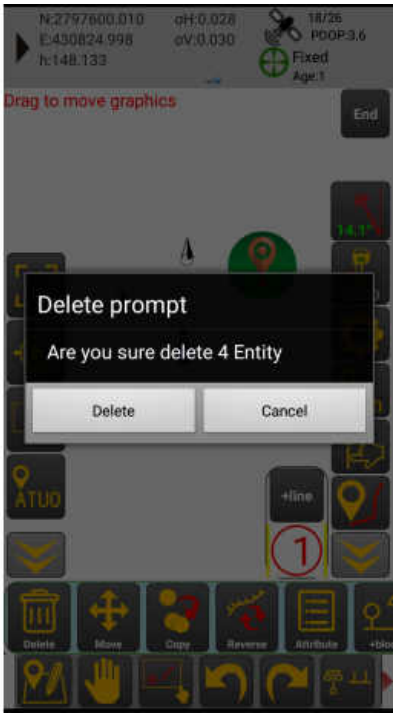


Figure 4-30

[Delete] Click the "Delete" button will pop up a dialog box asking whether to delete, such as Figure 4-30, to determine the deletion of the selected elements of the map, press 【Undo】 to undo the deletion.

[Move] Move the selected elements of the operation, click the "Move" button, prompted by "click or drag to specify the base point", first click on the screen to specify a reference point for panning, and then click or drag to specify the insertion point of the panning to complete the panning, such as Figure 4-31, press the Undo to undo the move.

[Copy] Copy the selected elements of the operation, click the "Copy" button, prompt "click or drag to specify the base point", first click on the screen to specify a copy of the reference base point, and then click or drag to specify the

insertion point of the copy.

Note: Copy for multiple copies, keep clicking on the insertion point of the graphical elements that are constantly being copied, click on the upper right corner of the [End] button to complete the copy, and click on the [Undo] button can also complete the copy.

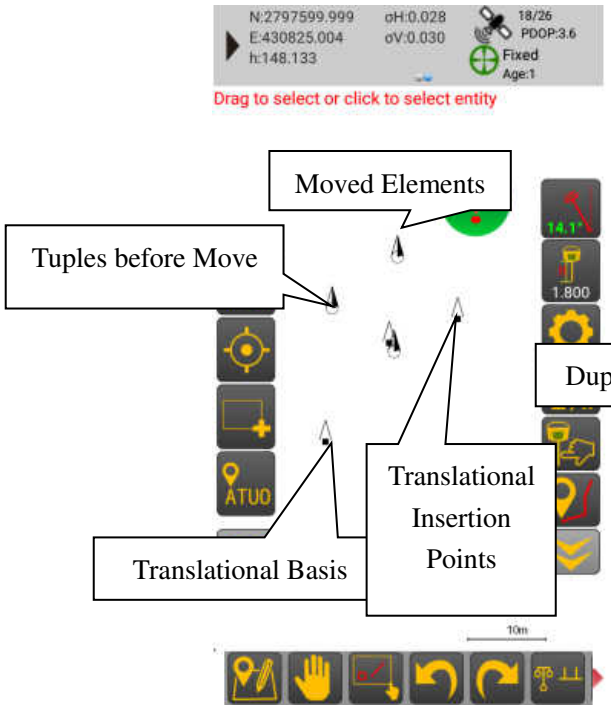


Figure 4-31

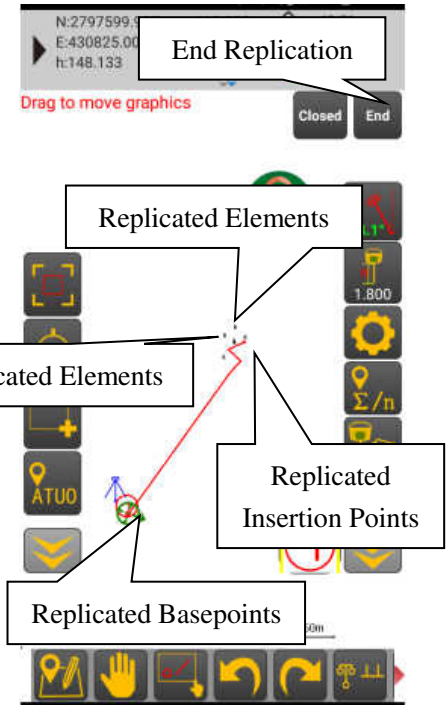


Figure 4-32

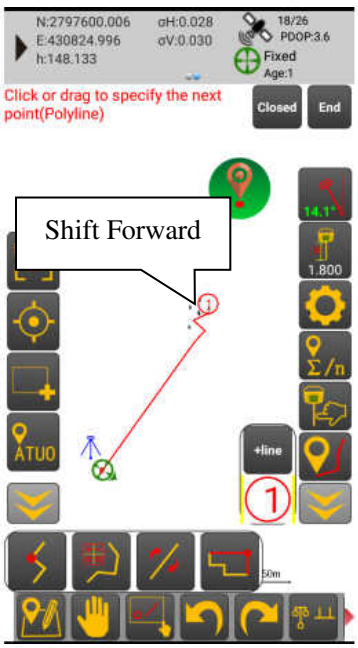


Figure 4-33

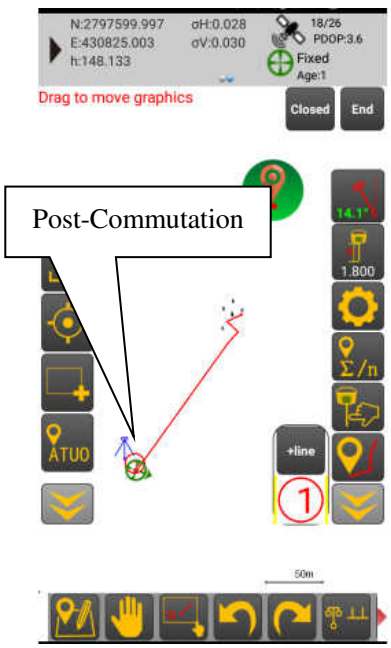


Figure 4-34

[Linear Commutation]

For the polyline with line types such as cans, slopes, etc., the line type needs to be matched with the field terrain, if the line type needs to be reversed in the opposite direction, you can select multiple polylines to be reversed, as in Figure 4-34.

Note: When selecting a polyline, if you select other elements that are not polylines, only the polyline will be operated.

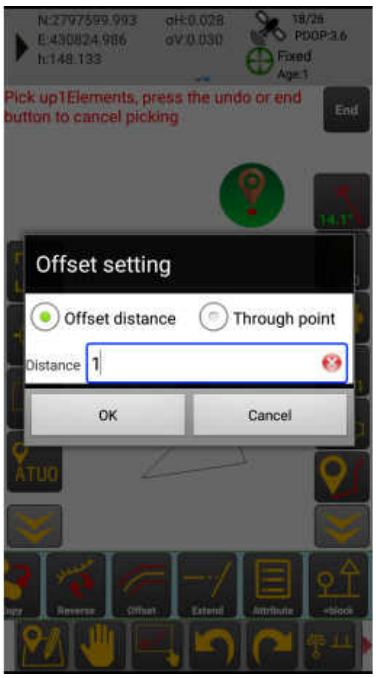
When drawing a polyline if the line needs to be reversed, end the polyline long pressing the [End] or [Close] button can be reversed.

[Offset]

In the case of selecting only one polyline, the Offset button will be displayed, click the [Offset] button to pop up the Offset Parameters dialog box, as in Figure 4-34-1, including two types of offset: enter the specified distance offset, offset by a specified point.

1. Specified Distance Offset: Enter the offset distance, click the OK button to close the dialog box, and click on the screen to specify the direction of the polyline offset, left or right.

2. Offset by specified point: the offset line passes through the specified point, click the OK button to close the dialog box, and click or slide on the screen to determine the point through which the offset passes.



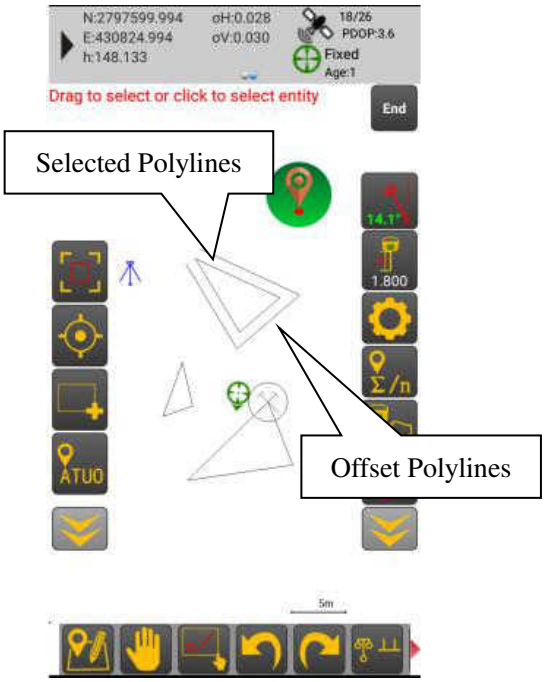


Figure 4-34-1 Figure 4-34-2

[Property Search]

In the case of a boxed element click on the [Properties] button to query the attributes of the element (the use of symbol library commands to draw graphics only have attributes), including the entity code and entity name, such as Figure 4-35 for the attributes of the street lamp symbols, export graphics to the CASS using the command "v" query attributes.

Figure 4-35

[Modify Text]

In the case of selecting a text element, you can modify the text content and word height;

[Withdrawn] [Redo]

You can undo and redo operations including drawing, deleting, moving, and copying of elements. (Note: After undoing a new operation is performed, the so-called new operation that is, after undoing the drawing element is redrawn or deleted, etc., at this time the undone content can not be redone.)

The Undo button, in addition to undoing a drawing that has already been completed, when duplicating a drawing element, the first click on the Undo button is the end of the duplication, and the drawing prompt will be prompted accordingly.

[Localized Graphic Export]

The selected graphs can be exported individually as a graph file, coordinate file, etc.

Box the graph and click the [Export] button, you can select the file format for export, as in Figure 4.2.4-1. You can export the exported partial graph to a computer or share it with other surveyors.

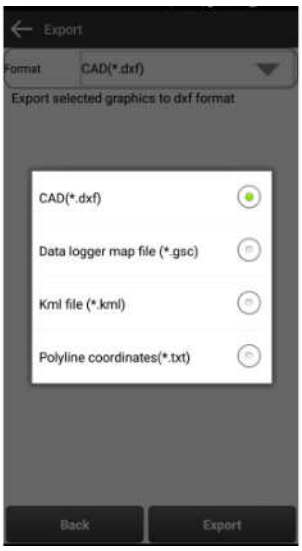


Figure 4.2.4-1

4.2.5 Custom Symbols

The software supports the creation of customized symbols (CAD reference block), some repetitive graphics, and symbols notes, users can create customized symbols on the handbook software, the creation of symbols and standard symbols in the library of the same symbols, the figure specified insertion point can be drawn.

1. Create Symbol

Select the graph at least 2 graphs by picking on the graph (the graphs can not contain other reference blocks and ingest types), as in Figure 4-36, and click the [Create Block] button to pop up the Create Block form, as in Figure 4-37. input the block name (can not contain Chinese) and symbol description (will be displayed in the symbol list). The base point is the reference point for inserting the block, the default is the center of gravity coordinates of the graph, you can modify the base point by selecting it on the graph, manually inputting it, and so on. Click the [Create] button to finish symbol creation.

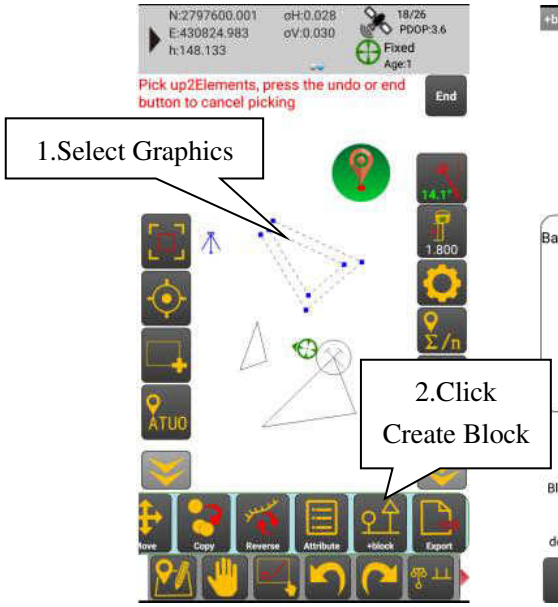


Figure 4-36

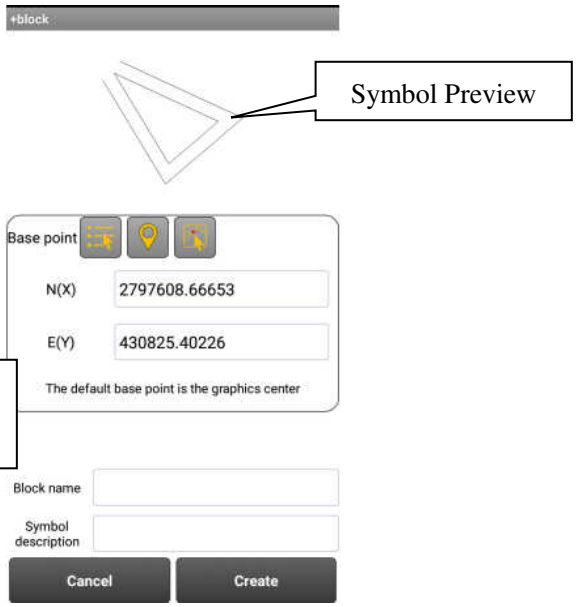


Figure 4-37

2. Drawing Symbols

After the custom symbols are created successfully you can select the symbols in the [Custom Block] button of the symbol library, and the drawn symbols are in the recently used symbols list for easy and quick selection.

There are two ways to draw symbols: **single-point insertion of symbols, and**

rotated symbols. You can set whether to support rotation when inserting a block in the Customize Symbol form. Single-point insertion is drawn by clicking only one point, and symbol rotation is supported when the first point is the insertion point and the second specifies the direction of rotation.

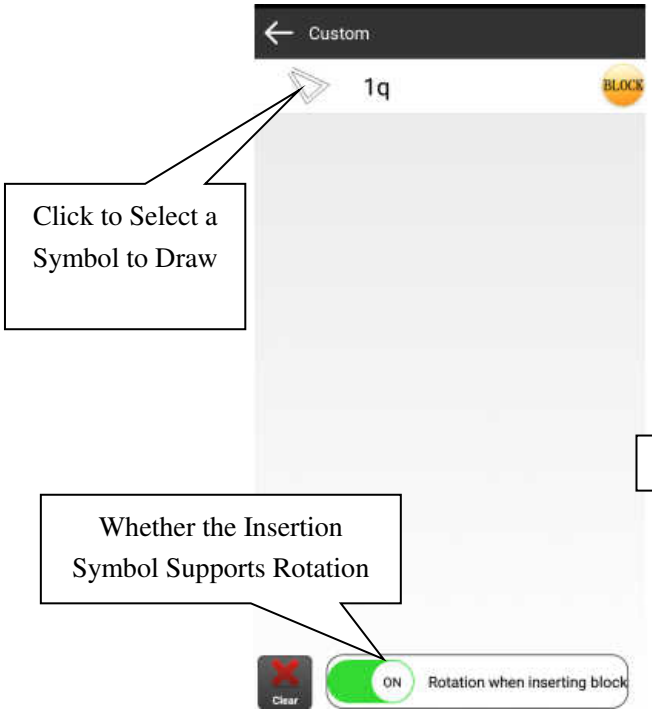


Figure 4-38

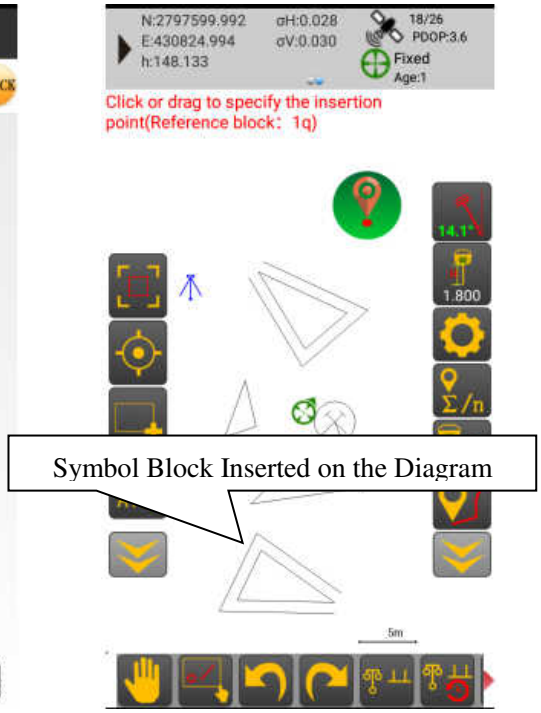


Figure 4-39

A symbol can be deleted by long-pressing on it in the Custom Symbols form.

Tips:

1. Delete the symbols in the custom symbol library will not delete the symbols already drawn on the drawing, but when exported to CAD this symbol will be blown up on the drawing instead of a reference block;

2. The export graphics file (dwg/dxf) open in CAD, you can insert a command to select the appropriate block name to draw custom symbols.

4.3 Measurement Function

4.3.1 Measurement Point

Clicking the [Measurement Points] button of the vertical toolbar can enter the fragmentation point interface to display the recorded points, as in Figure 4-40 you can modify the point name, code, and antenna height, and select the antenna type. Click [Save] to store the point, click [Cancel] to abandon the storage.

Roll Call: The roll call serial number is automatically incremented by 1 for each collection;

Code: Auxiliary information records, using the code of the code mapping

Antenna Height: Generally use the height of the pole, such as Figure 4-41, if you modify the antenna type, click on the antenna type to modify.

[Disable the elevation of this point] When you turn on the switch, you can filter out the elevation point when exporting dxf graphics, if you export elevation points at the same time. In some cases, the collected elevation is not accurate, for example, if you lift up the alignment bar to measure, and you don't want the elevation value, but only the point position, then you can turn on the disable elevation switch, and then you can filter out the disabled points when exporting elevation points.

When [No longer display this form when measuring] is checked, the next time you click the [Measurement] button, the measurement point interface will no longer pop up, but the point will be stored directly.

Note: Long pressing the Measurement Point button will bring up the Measurement Point Information interface in Figure 4-40.

A fragment point consists of a dot (node in object snap) and a point number.

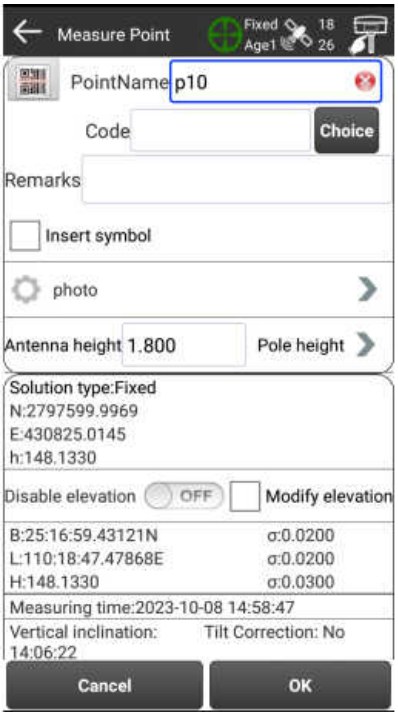


Figure 4-40

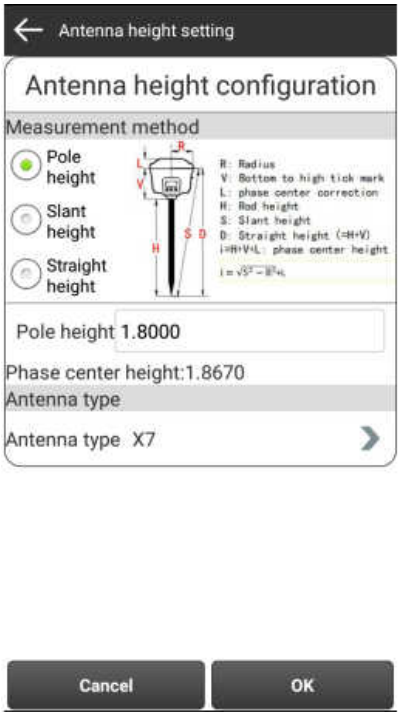


Figure 4-41

4.3.2 Line Measurement, Multiple Measuring Tape

Click the [Line Measurement] button on the vertical toolbar to store a fragmentation point while automatically connecting the polyline, as shown in Figure 4-42. The line measurement function is more commonly used when measuring and drawing, and the line measurement and manually drawing polylines can be executed alternately with each other. At the end of the line measurement, click the Close or End button to finish the polyline drawing.

Three operations are performed each time a line is measured:

1. Collect a fragmentation point;

2. Connect the current fragmentation point to the end point of the unterminated polyline (a polyline is automatically started when there is no unterminated polyline at present).

3. Switch the drawing command to polyline mode.

Measurement lines and manually drawing polylines often alternate with each

other, for example, if there are already several measurement points on the map, manually connect these points with polylines, but also want to continue to measure the line down, then manually connect the line after the polyline do not end the polyline, go to the next point of execution of the measurement line function can continue to be connected. If you want to connect the polyline to an existing point halfway through the measurement, you can connect it manually.

You can also switch to other drawing commands or operations when the line is not finished, for example, if you want to insert a rice paddy symbol during the line measurement, you can continue to connect the line after inserting the symbol. For example, if you want to measure an elevation point halfway through the process of measuring a road, you can click "Measure Points" to measure an elevation point, and then you can continue to measure the line.

Note: When you use the attributed polyline in the symbol library to measure the line, switch to other non-polyline drawing commands, and after the other commands are finished, if you want to continue to draw the attributed polyline, you can click on the [Polyline] button on the drawing toolbar to continue to draw, or you can re-select the polyline in the symbol library.

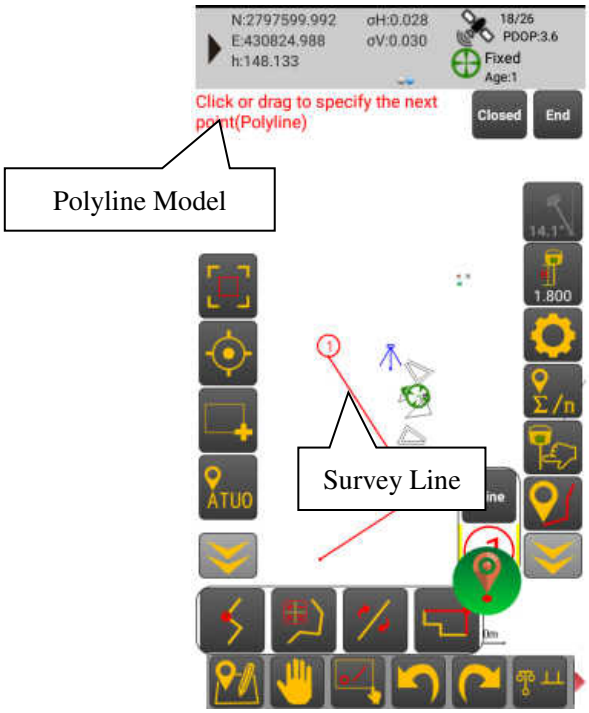


Figure 4-42

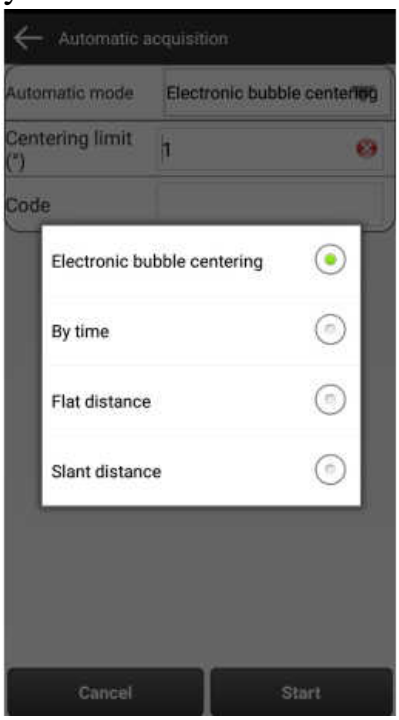


Figure 4-43

Note: Long press the line measurement button automatically connects the

polyline but does not save the measurement point, when the polyline point is denser, you can only connect the line without recording the point.

[Multi Ruler]

Using the Multi Ruler function, you can measure and draw multiple lines at the same time. During the process of drawing multiple lines, the [Multi Ruler] toolbar is displayed in the lower right corner of the screen, as shown in Figure 4.3.2-1. Clicking on the [Add Line] button creates a new line, and clicking on the line number in the list switches the current line. Long press the line number in the list can switch the current line and perform the line of measurement points. The number of the currently plotted line is shown in red on the graph, and the non-current line is shown in blue.

Clicking the Close or End button after measuring a line will renumber the lines on the graph.

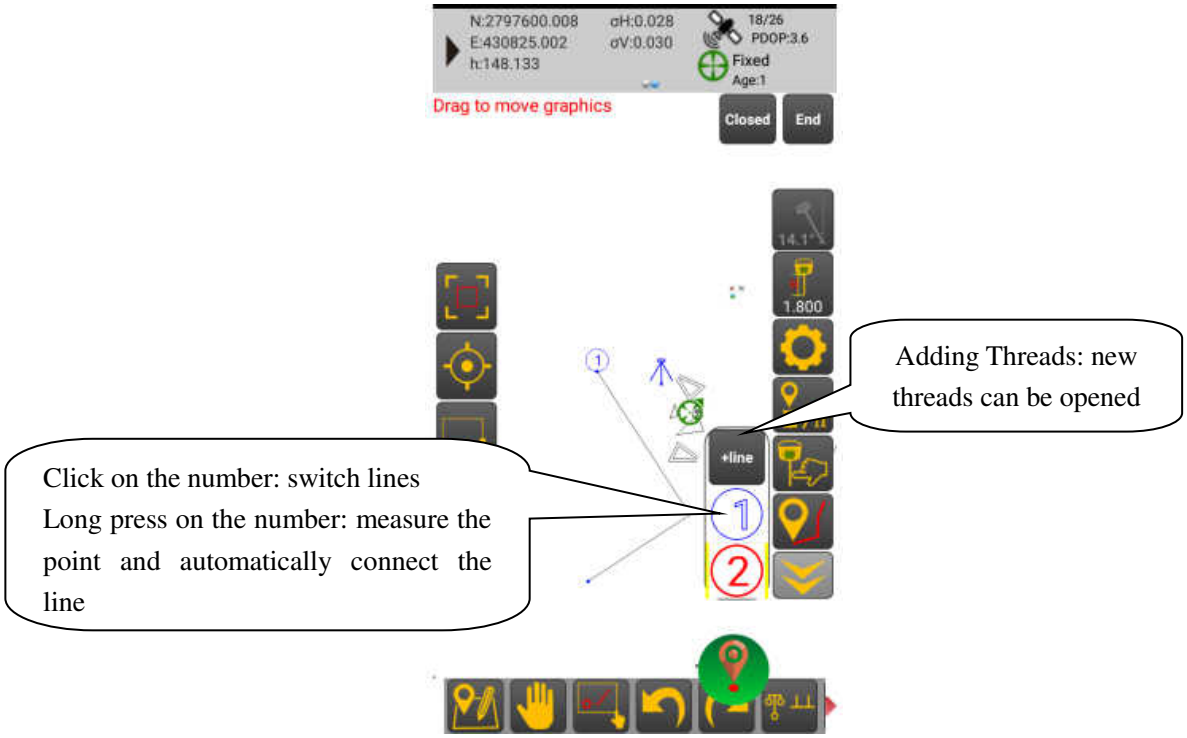


Figure 4.3.2-1

4.3.3 Automatic Acquisition

Click the [Auto] button of the vertical toolbar to enter the automatic acquisition

setting interface, as in Figure 4-43.

The automatic acquisition methods include acquisition when the electronic bubble is centered, acquisition by time interval, and acquisition by distance interval.

Electronic bubble centered collection: bubble two-axis tilt less than the specified tilt angle automatically collects points, measurement only needs to be centered rod can be collected, each time the collection is completed will wait for 5 seconds after the implementation of the next centering judgment.

Acquisition by Time Interval: Points are automatically acquired at set time intervals.

Acquisition by Distance Interval: The current point is automatically acquired when the distance between the current point and the previous acquisition point is greater than the set distance (according to the flat distance or diagonal distance).

Code: The code of the point number record, can be empty.

Click the [Start] button to start automatic acquisition, at this time the [Auto] button changes to [Stop], clicking the [Stop] button during automatic acquisition can end the automatic acquisition mode, and exiting the graphical interface will also end the automatic acquisition.

If the accuracy does not reach the set limit value during acquisition, a dialog box will pop up to prompt whether to acquire or not.

4.3.4 Smooth Acquisition

Smooth Acquisition: Acquire multiple points continuously to take the average value to improve the accuracy of measurement.

Click the [Smooth] button on the vertical toolbar to enter the Smooth Acquisition interface, as in Figure 4-44.

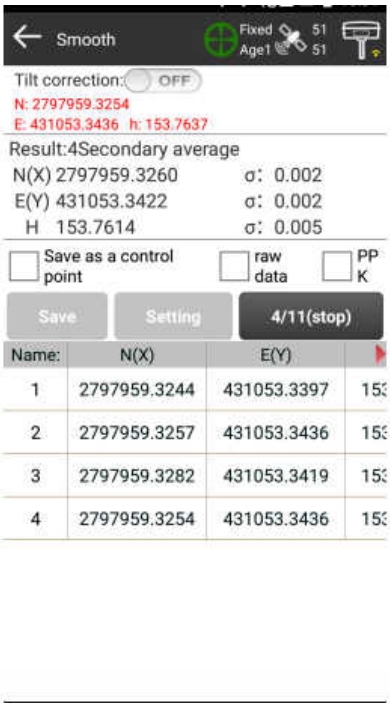


Figure 4-44

Figure 4-45

[Start] to start smoothing acquisition, when the GPS solution type reaches the requirements of the limit to start acquisition, if the solution type is not satisfied will prompt the data quality is not good and pause the acquisition. Click [Stop] to end the acquisition. During the acquisition process, the software calculates and displays the average value and center error of the acquisition points in real-time.

After the smoothing acquisition reaches the number of smoothing times to stop the acquisition, the last three columns of the list show the difference between each point and the average value, such as Figure 4-45, in the list of points can be deleted according to the need for deviation of large points, long press the smoothing list item pop-up deletion dialog box, the software will automatically recalculate the average value.

[Save] can save or return the average value to the form that needs to collect points, and you can only click it when you end the collection.

There are two cases of smoothing acquisition: 1, in the measurement interface to enter the smoothing acquisition form, at this time, is for the acquisition of a point to save to the point library, the default is saved in the measurement point library, if you check the box【Save for control point】will be saved in the control point library; 2, to get a point for other purposes for smoothing the acquisition of the case, such as to get

a point to set up a datum station coordinate, etc., at this time, click on the 【Save】, just the measurement point will be returned to the In this case, clicking [Save] will only return the measurement point to the form that needs the point, and it will not be saved to the measurement point library; checking [Save as Control Point] will save it to the control point library!

Set the number of smoothing acquisition, smoothing acquisition interval (sec), solution type, and smoothing accuracy limit, as in Figure 4-46.

Solution Type: When the solution type of RTK in smoothing acquisition reaches or higher than the set requirement, the acquisition will be paused until it reaches the requirement, as in Figure 4-47.

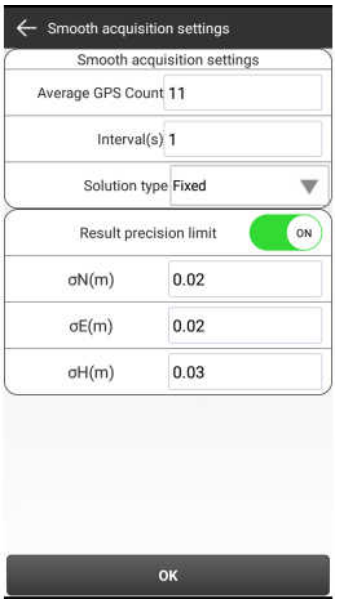
Smoothing Accuracy Limit: If it is set to on, a dialog box will pop up when the accuracy of the smoothing result is not up to the set requirement when it is saved, as in Figure 4-48.

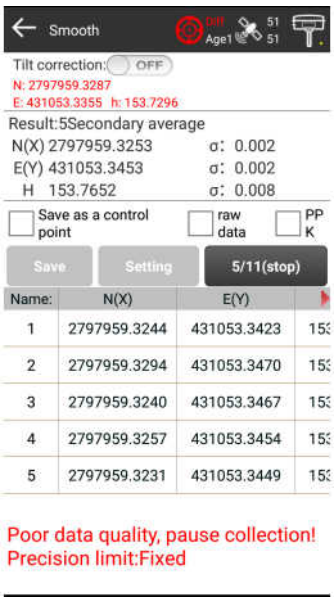
[PPK] When using the PPK measurement function, the reference station and mobile station need to record the static file at the same time, so that the coordinates can be calculated by post-processing in the absence of differential signals. If you check PPK in the smooth acquisition interface, the point will be marked as PPK measurement point. In the data import and export interface, you can import the post-processing result file to correct the coordinates of the PPK measurement point.

Note: Do not check the PPK option when collecting non-PPK measurement points, so as not to be treated as PPK measurement points to correct the coordinates during post-processing.

[Bubble] Click the bubble to enlarge the display.

[Tilt Correction] Turn on or off the tilt correction function.





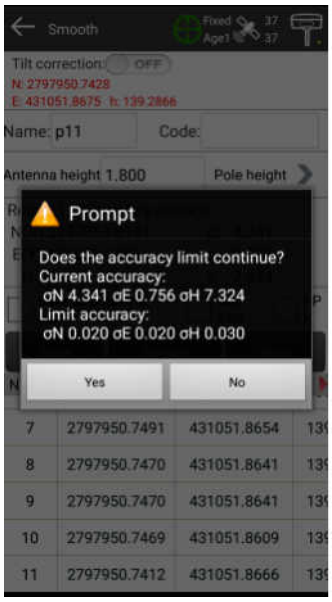


Figure 4-46 Figure 4-47 Figure 4-48

4.3.5 Concealed Point Measurement

GoodSurvey software provides 2 ways to measure hidden points (house corners, etc.): single point tilt measurement, and offset measurement.

1. Single-Point Tilt Measurement

As shown in Figure 4.3.5-1, the alignment rod is tilted up to 30 degrees and the 3D coordinates of the rod tip position are calculated by the built-in sensor. Before using the tilt correction, you need to calibrate the electronic bubble and electronic compass (refer to section 4.7 Tilt Sensor Calibration), the magnetic field affects different measurement zones differently, so it is recommended to calibrate the electronic compass before using the tilt correction function when changing the measurement zone.

When measuring, turn on the tilt correction switch, as in Figure 4.3.5-2, after turning on the tilt correction, the coordinates displayed in the interface are the coordinates corrected to the rod tip position.

Note: The main unit must be in a stationary state without shaking when collecting points, and the tilt must be within 30 degrees to ensure that the antenna height is input correctly.

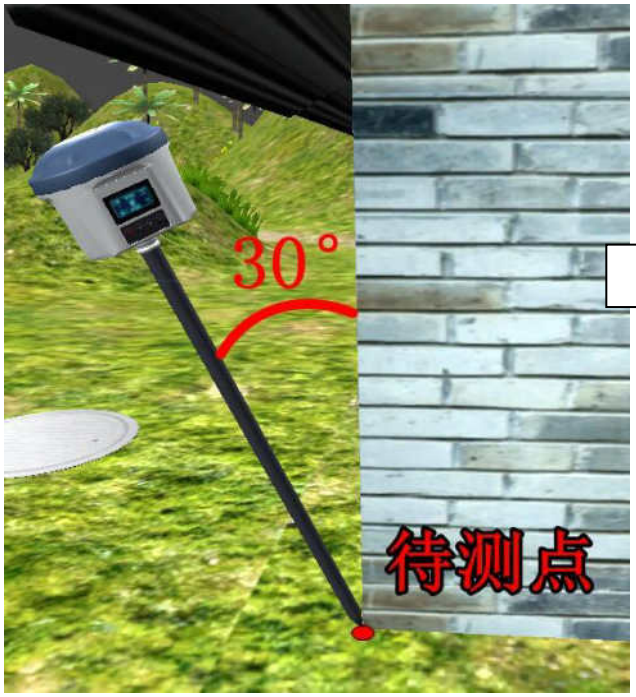


Figure 4.3.5-1

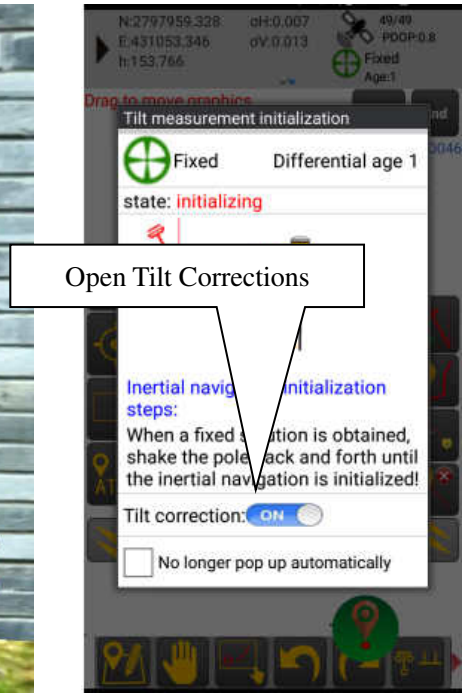


Figure 4.3.5-2

4.3.6 Point Measurement

In the measurement page of the main interface, click the [Point Measurement] button to enter the text interface of the fragmentation point measurement, as shown in Figure 4.3.6-1. The main difference is that the graphical interface is different from the graphical interface so users who like to use coded mapping can collect the points only for the purpose of collecting them without mapping.

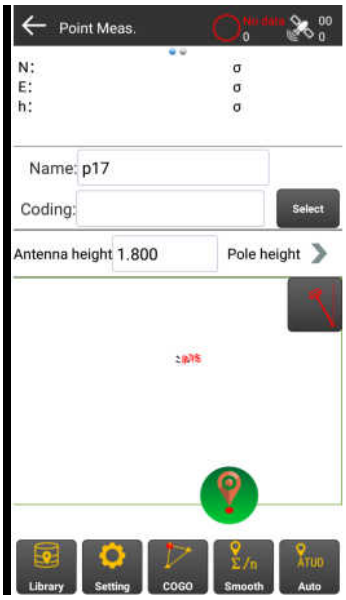


Figure 4.3.6-1

4.4 Point Stakeout

In the measurement page of the main interface, click the [Point Stakeout] button to enter the point stakeout interface, as shown in Figure 4-49.

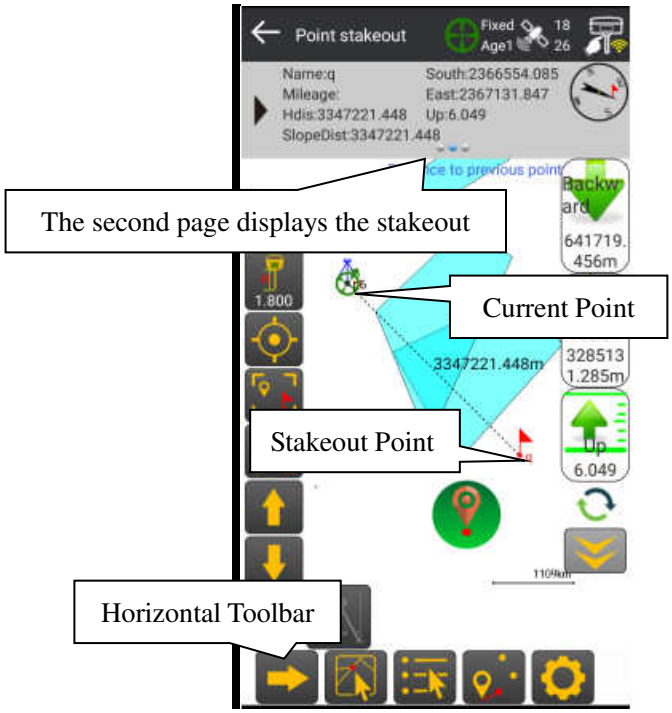


Figure 4-49

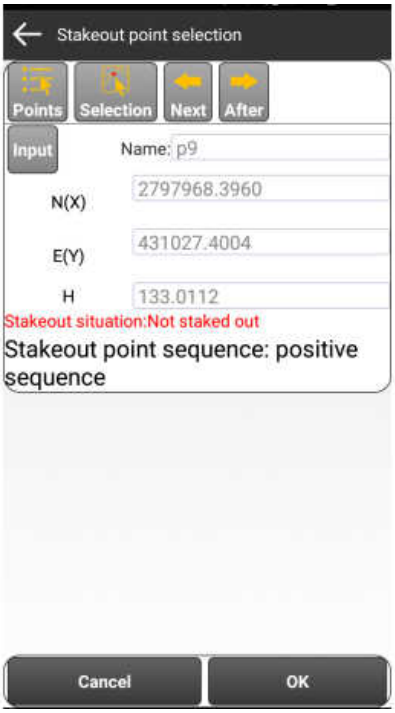


Figure 4-50

Generally, the stakeout point is imported before point release, and the stakeout point can be imported in "Import and Export".

Note: It is better not to rename the imported stakeout points;

[Next Point] Enter into the interface of releasing point selection, such as Figure 4-50, every time you enter into the point selection form, the points in the point selection interface will be recursive to the next point according to the positive order or reverse order.

[Point Library] Select a point (can be a stakeout point, measurement point, or control point) for stakeout through the point library.

[Drawing] Select a point (point library) or click to select a point (point at any position on the screen, can capture the point on the graph, the base map) for sampling, such as Figure 4-50-1.

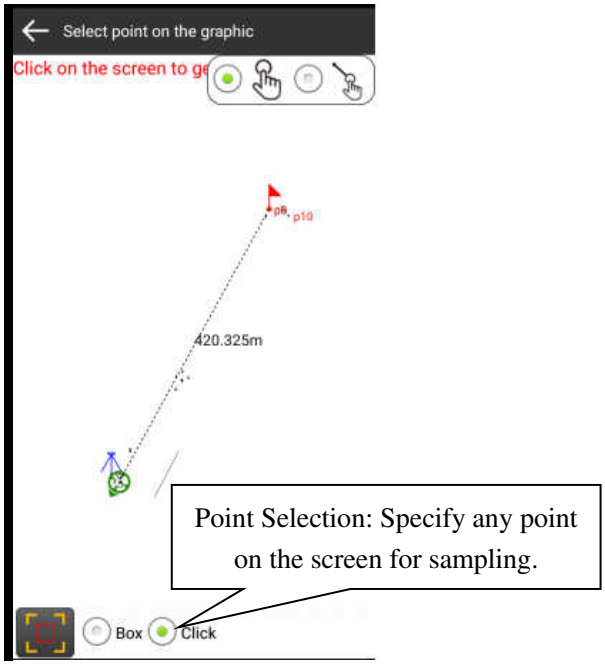


Figure 4-50-1

[Input] Manually input a stakeout point coordinate for release, such as Figure 4-51, you can save the input point to the stakeout point library, the point number can not be renamed.

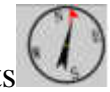
Clicking on [Previous point] or [Next point] allows you to select a point from the

layout point repository in reverse or forward order with an increment of 1.

Layout point order: When selecting the next layout point, the layout points are incremented in either forward or reverse order. This can be modified in the settings. Previously laid out points will be indicated as already laid out when selected.

Clicking on [OK] will return to the layout interface, and the graphic interface will center the current point and the layout point on the screen. If the selected point is not in the layout point repository, a prompt will appear saying “The current point does not exist in the layout point repository.Continue with the layout?”

The screen displays in real-time the line and distance between the current point and the layout point. The second page of the top information bar displays layout prompts, such as the walking distances towards the north, east, etc., and the height difference between the current point and the layout point. The compass on the device can be used to navigate in the correct direction.

The arrow on the compass icon points  to the direction of the layout point. Clicking on the compass icon displays a target point orientation view, as shown in Figure 4-4-1.

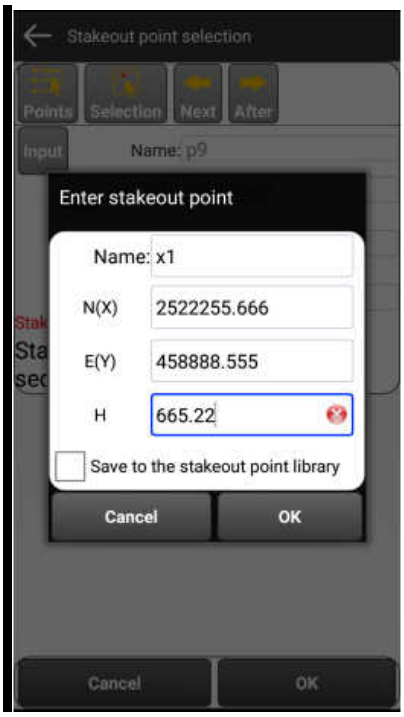


Figure 4-51

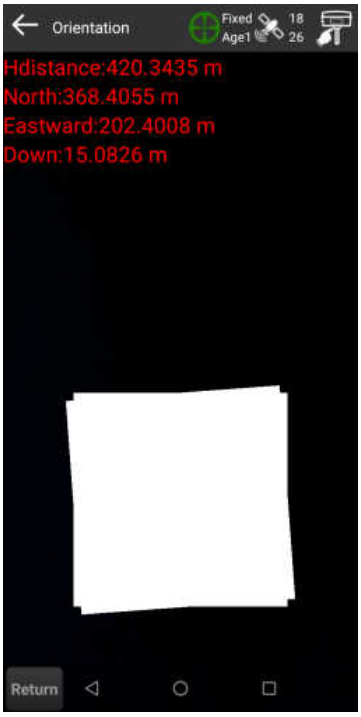
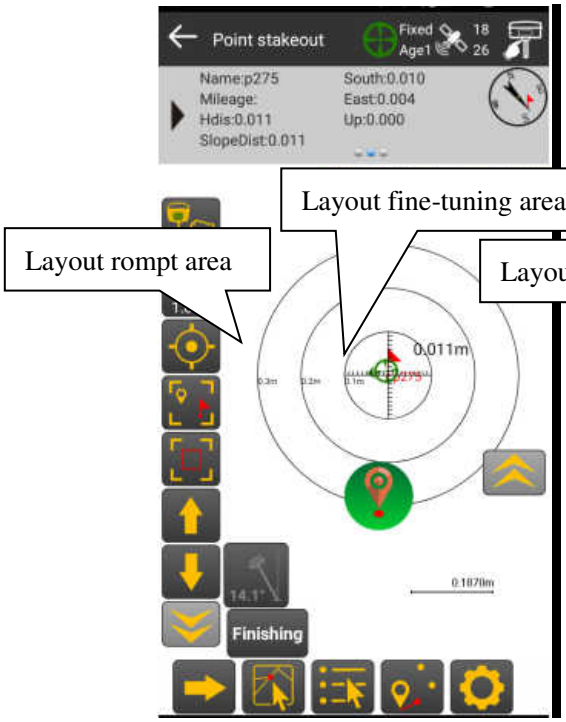


Figure 4-4-1



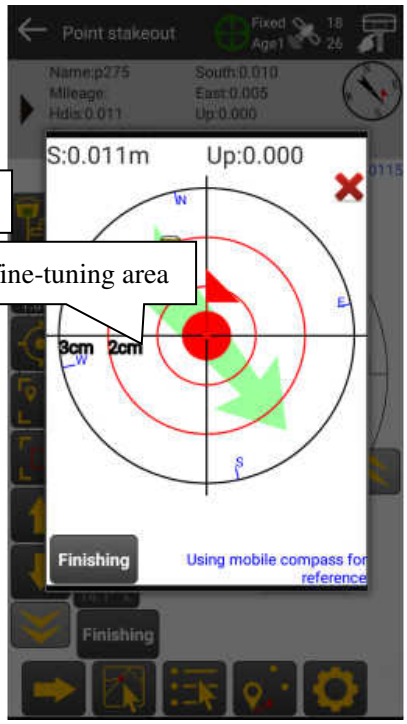


Figure 4-57 Figure 4-58

Whether to repeat the layout: When the repeat layout is turned off, selecting the next layout point or selecting the nearest layout point will skip the points that have already been laid out. If set to enabled, the points that have been previously laid out can still be selected again.

Layout prompt area: When users enter the layout prompt area, the graphics will be scaled and centered on the screen within the prompt area. The radius of the prompt area is three times that of the fine-tuning area, as shown in Figure 4-57.

Layout fine-tuning area: The fine-tuning area is where the receiver enters this radius range and displays the image in fine-tuning mode, as shown in Figure 4-58. It allows the receiver to be moved to the layout point according to the scale on the diagram. The fine-tuning radius can be set within the range of 0.1 to 1 meter, adjusted according to different layout precision requirements.

[Recent] Clicking the “Recent” button will automatically find the point closest to the current point in the layout point database for layout, enabling quick selection of the next layout point.

[Zoom] Zooms in and centers the screen display on the current receiver

position and the target layout point.

[Center] Displays the current position of the mobile station in the middle of the screen.

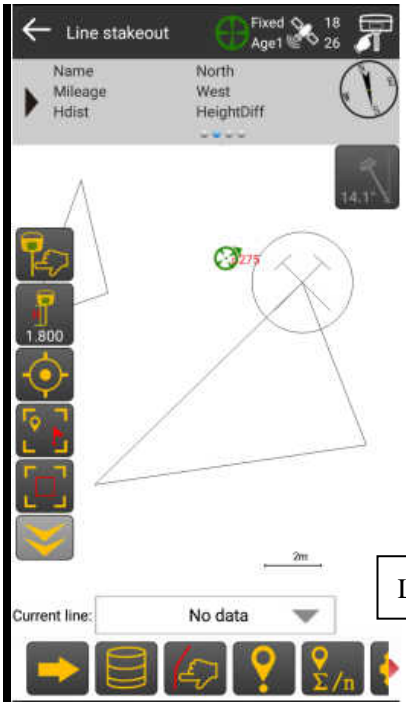
[Finish Layout] When the mobile station enters the layout prompt area, the fine-tuning area is displayed along with the [Finish Layout] button. When the layout accuracy is achieved, click the “Finish Layout” button in the bottom right corner. The current layout point will be marked as completed. You can check whether it has been laid out in the last column of the layout point database.

Points that have not been laid out are displayed in red on the diagram, marked with symbol . Points that have been laid out are displayed in blue on the diagram, marked with symbol .

4.5-line layout.

Line layout refers to localized linear layout. The software provides three basic types of line layouts: straight lines, arcs, and smooth curves. The layout of a line segment is equivalent to the layout of a line route, and the position of each layout point is determined by mileage as a unique index.

On the measurement page of the main interface, click the [Line Layout] button to enter the line layout interface, as shown in Figure 4-59.



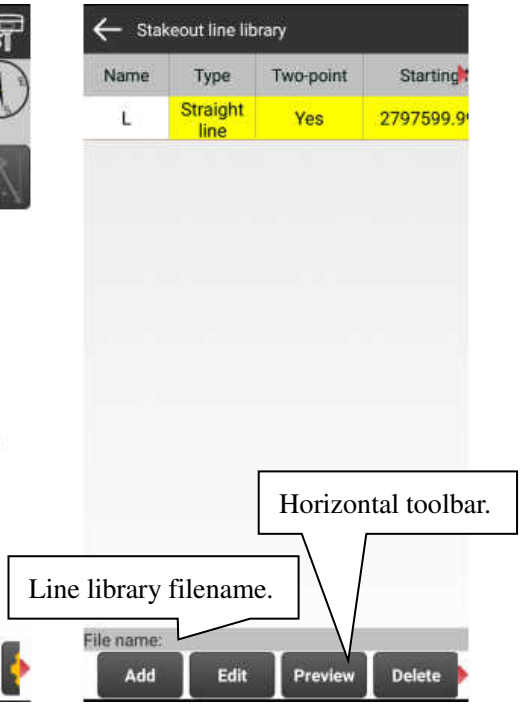


Figure 4-59 Figure 4-60

Before performing layout, you need to add line types first. Click the [Line Library] button on the bottom toolbar to enter the layout line library interface, as shown in Figure 4-60. The bottom horizontal toolbar can be scrolled left or right, providing functions such as adding, editing, previewing, deleting, loading, saving, and saving as.

[Add] can add straight lines, arcs, and smooth curves, as shown in Figure 4-61.

Define a straight line.

As shown in Figure 4-62, there are two ways to define a straight line: “Two-point Line” and “One-point + Bearing Angle”. If you choose “Two-point Line”, you need to define the coordinates of the starting point and endpoint of the line. The coordinates can be obtained from the point library or measured. If you choose “One-point + Bearing Angle”, you need to enter the coordinates of the starting point, bearing angle, and distance of the line. Enter the line name and starting mileage, then click [OK] to complete the addition.

Define an arc.

As shown in Figure 4-63 and Figure 4-64, there are two ways to define an arc: “One-point + Bearing Angle” and “Two-point Arc”. If you choose “One-point + Bearing Angle”, you need to enter the starting point, bearing angle, radius, length, and arc deflection of the arc. If you choose “Two-point Arc”, you need to enter two points, arc radius, and deflection. Enter the line name and starting mileage, then click [OK] to complete the addition.

Figure 4-61

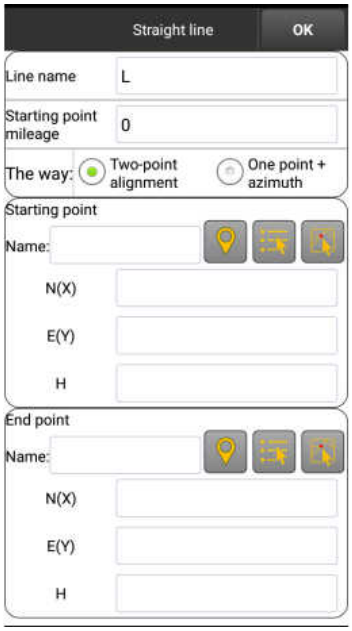


Figure 4-62

Figure 4-63

Define a transition curve.

In Figure 4-65, to define a transition curve, you need to input the line name, starting coordinates, starting mileage, deflection direction, length, and the bearing angle of the tangent at the starting point.

Starting radius: The starting radius of the transition curve. Selecting “∞” indicates an infinite radius, which means a straight line.

Ending radius: The ending radius of the transition curve. Selecting “∞” indicates an infinite radius, which means a straight line.

lick [OK] to add the transition curve.

Note: The starting point and ending point cannot be both defined as “∞” (representing a straight line). If you want to define a straight line, please choose the option for line definition.

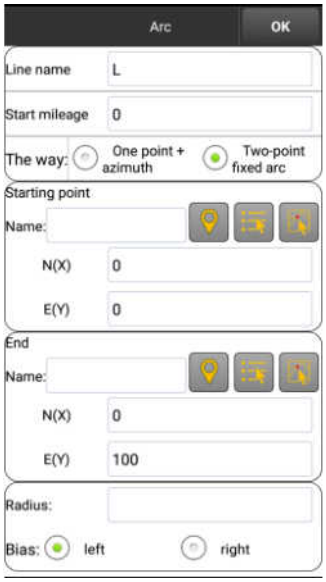


Figure 4-64

Figure 4-65

Figure 4-66

[Edit]: Selecting a line from the online library allows for editing.

[Preview]: After selecting a line from the online library, click the [Preview] button to access the graphical preview interface, as shown in Figure 4-66. This allows for an individual preview of the current line design. By clicking the [Calculate] button, you can input mileage and offset to calculate the coordinates, or input coordinates to reverse calculate mileage and offset, in order to verify the accuracy of the line design.

[Delete]: Selecting a line from the online library allows for deletion.

[Load]: Load data from a line file (*.line).

[Save]: Save all current line geometries to a file (*.line).

[Save As]: Save all current line geometries to a different file (*.line).

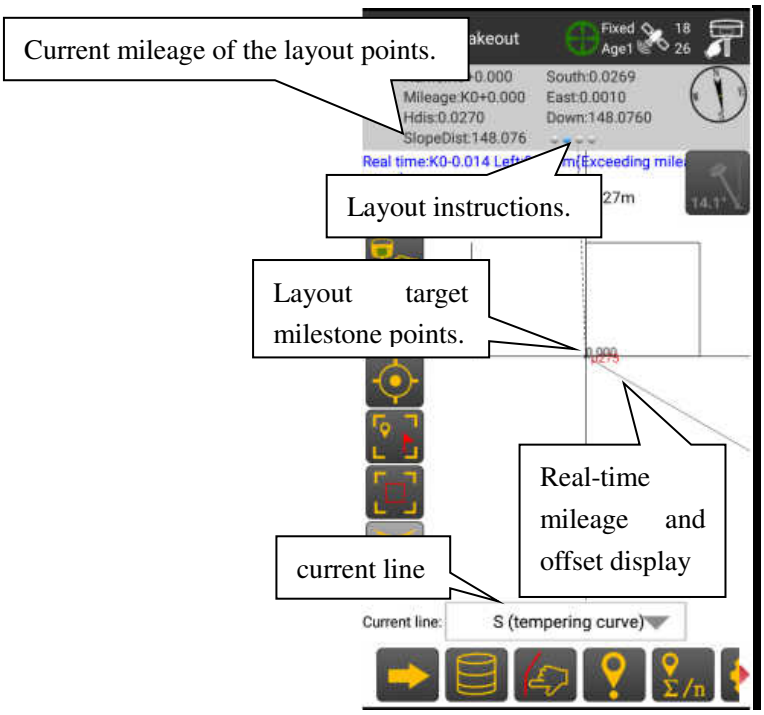


Figure 4-67

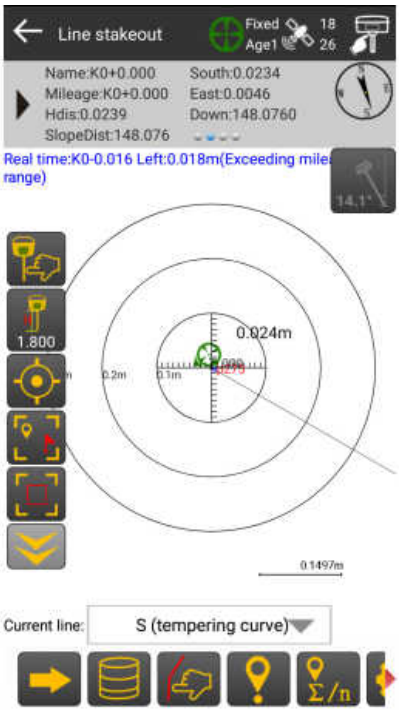


Figure 4-68

Line layout process

The line layout is equivalent to the layout of a line route. The position of each point in the layout is determined solely by the mileage as a unique index. Please select the desired line to be laid out from the [Current Line] list in the bottom toolbar, as shown in Figure 4-67. The default initial layout point is the starting mileage of the line.

[Next point]: Clicking on [Next point]will enter the interface for setting sampling points, where you can input the mileage of the point to be laid out. The mileage and offset will be automatically accumulated based on the increment.

In the interface for setting sampling points, you can input the mileage to calculate the position of the layout point. By clicking the "Up" and "Down" buttons, you can manually increment or decrement the mileage by the set increment. For example, if you want to lay out a stake every 10 meters, you can set the increment to 10. Suppose the starting mileage of the layout point is "0", after completing the layout of the first point and entering the sampling point interface again, the software will automatically increment the mileage to "10". Simply click "Confirm" to carry out the layout at the position of mile 10.

Mileage: The mileage of the current layout point.

Mileage Increment: The increment value for the mileage each time the form is entered.

Offset: The distance in the direction of increasing mileage that deviates from the perpendicular line of the defined segment.

Offset Increment: The incremental increase in offset value each time the form is entered.

"Offset" is commonly used when aligning roadway boundary markers. "Orientation" is set to either "Left" or "Right," representing the left or right side of the alignment respectively. The offset value is the distance from the centerline to the boundary line, and by setting the increment to 0, you can align the boundary markers at the specified mileage.

After specifying the mileage, a layout point is determined. The specific process of locating the layout point is the same as the point layout method, as shown in Figure 4-68.

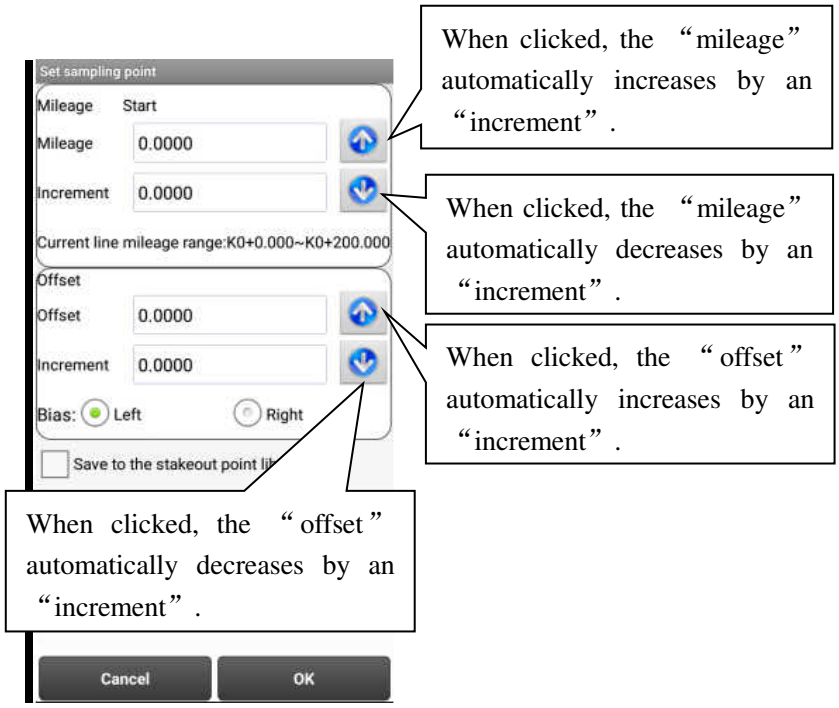


Figure 4-68

In order to guide to the target point, the software draws a line connecting the target point and the current point. By ensuring that the current walking direction (indicated by the direction symbol of the current point's position and velocity direction) aligns with this connecting line, the walking direction can be ensured to be correct.

The information prompt bar at the top of the software provides layout instructions, indicating the walking direction and the horizontal and vertical differences. The direction can be determined through the handheld electronic compass.

Tip: You can enable the real-time mileage feature in the display settings. The software will project the current location point onto the route (represented by a small dot on the route indicating the projected position) and display in real-time the line connecting the current point to the projected point, as well as the mileage and offset of the projected point.

[Zoom] Zooms in to display the current point and target layout point in the center of the screen.

4.6 Surface Layout.

Surface layout begins with the establishment of a DTM (Digital Terrain Model), which is a digital representation of the terrain. During the layout process, the software calculates the real-time height difference between the current point and the fitting point on the design surface.

In the measurement page of the main interface, click the [Surface Layout”]button to enter the surface layout interface, as shown in Figure 4-6-1.

Click on the [Surface Library] button on the bottom toolbar to enter the surface library design interface, as shown in Figure 4-6-2.

[Create Surface] Creates a new surface data by inputting a surface name and at least three coordinate points, as shown in Figure 4-6-3. You can add points individually or in bulk. Bulk addition of points can be done by importing from a file in CASS7.0 format (dat or txt), selecting multiple points from the point library, or selecting multiple points by drawing a box on the map. Clicking on Preview allows you to view the created Triangulated Irregular Network (TIN), as shown in Figure

4-6-6. You can check the correctness of elevation design values at specific locations by inputting coordinates or querying elevation values at any position on the screen.

[Load CASS Triangular Network] The creation of a new surface can read DTM triangular network files (dxf) generated by CASS. First, generate the triangular network in CASS, then save the dwg file as a dxf file and import it into the device. When importing the dxf file, the program only reads the triangular network data and ignores other data. It is not possible to edit or add points when importing triangular network data from a CASS file.

[Edit] Allows for editing of the selected surface data from the list.

[Preview] Preview the triangular network graph.

[Delete] Delete the selected surface data from the list.

[Load] Read surface data from the surface layout file (*.tin).

[Save] Save all surface data to a file (*.tin).

[Save As] Save all surface data to a new file (*.tin).

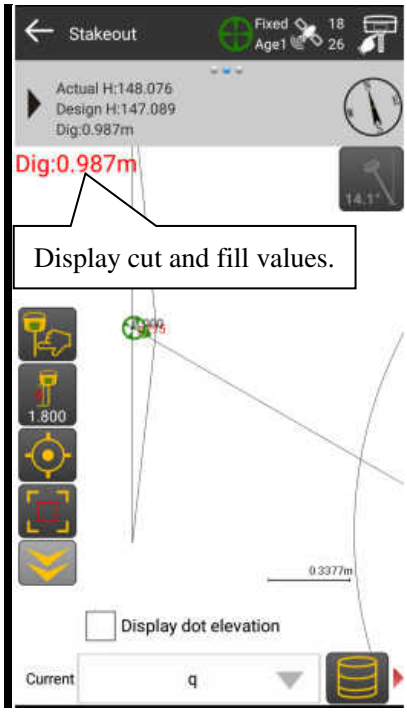


Figure 4-6-1

Figure 4-6-2

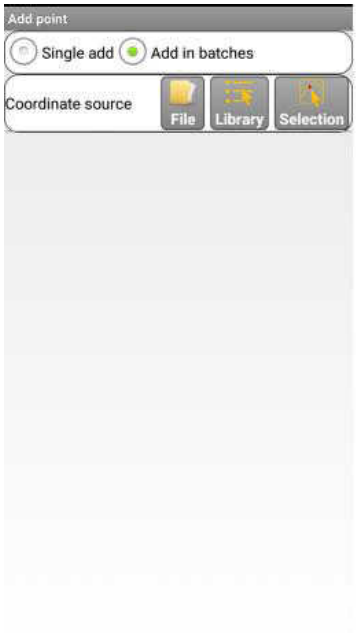
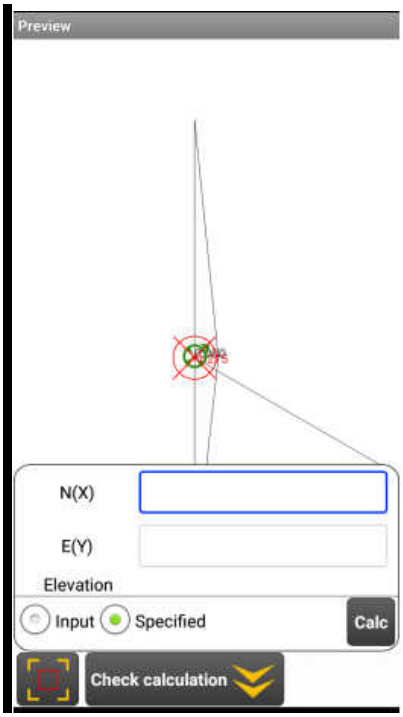


Figure 4-6-3 Figure 4-6-4 Figure 4-6-5

During surface layout, the cut and fill values are displayed in real-time at the top left corner. If the current point is outside the design surface range, it will prompt: “Out of area range”. Select the desired surface from the current surface list, as shown in Figure 4-6-7.When the [Display Node Elevation] option is checked, the elevation values of the triangulation network nodes are displayed on the graph.



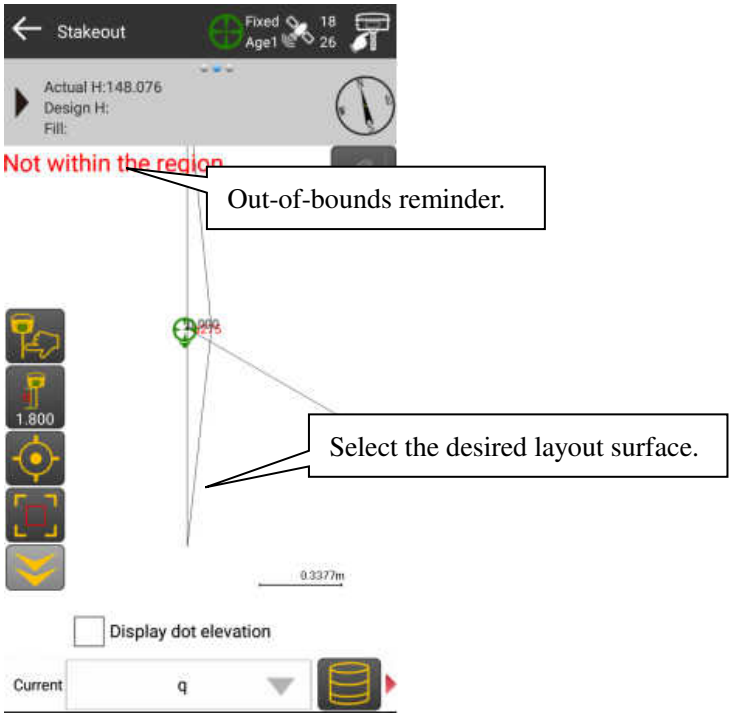


Figure 4-6-6 Figure 4-6-7

4.7 Configuration.

This includes the configuration of all parameters, including drawing, partial point measurement, road measurement, power measurement, and layout. Click the button on the bottom toolbar of the graphical interface to enter the settings interface, as shown in Figure 4.7.1-1. It is divided into four pages: “Display”, “Drawing”, “Measurement”, and “Layout”. You can swipe left or right or click the bottom options to switch between pages.

4.7.1 Display settings.

You can configure the display options for the measurement interface to enable or disable. This includes general measurement settings, road measurement settings, and power measurement configurations.

1、General measurement settings.

[Display Measurement Point Number] Whether to display the measurement point number, when turned off, the point numbers will not be displayed, but the positions (small dots) will still be visible. When performing surveying and mapping with the notebook, the focus is on the positions, and the point numbers are often not of concern. Turning off the display of point numbers makes the drawing clearer. It is recommended to disable the display during measurement and mapping!

[Display Measurement Point Elevation] When enabled, the elevation value of the measurement point will be displayed. If the elevation is displayed, the point number will not be shown, and only one of them can be displayed.

[Display Stakeout Points] Turn on or off the display of stakeout points (positions and point numbers).

[Display Control Points] Turn on or off the display of control points (positions and point numbers).

[Fixed Point Size]When enabled, the size of the point remains fixed on the

drawing, regardless of how the graphics are scaled. The point size displayed on the drawing will not change. When disabled, the point size will scale proportionally with the graphics (with a height of 1 meter). At a certain scale reduction, the point may become invisible.

[Display Scale] Choose whether to display the graphic scale at the bottom.

[Move Station Automatically Centered] When the station is not within the visible range of the screen, it will automatically be centered in the middle of the screen.

[Keep Station Centered] The station will always be displayed in the middle of the screen.

Note: When measuring and drawing simultaneously, it is recommended to disable the above two options, as enabling them may affect manual scaling of graphics and the drawing of elements.

[Display Bubble] Choose whether to display bubbles within the graphics area.

[Distance to Previous Data Point] Real-time display of the distance between the current point and the last measured point in the top left corner of the screen.

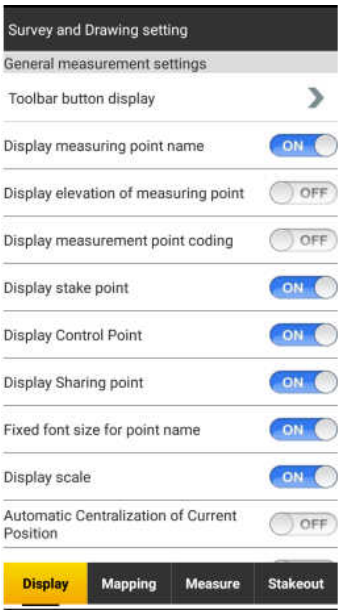


Figure 4.7.1-1

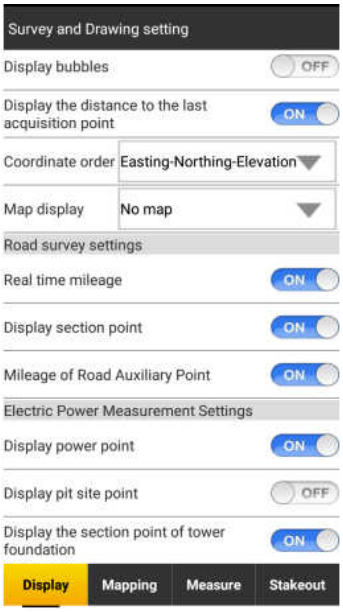


Figure 4.7.1-2

Figure 4.7.1-3

[Base Map Management] Configure the display parameters of imported base maps, as shown in Figure 4.7.1-3.You can import CAD graphics (dwg/dxf), shape files (shp), hand-drawn graphics (gsc), image files (tif), and picture files (jpg) as base maps. Multiple base map files can be imported, with each one being a separate layer. Layers can be enabled, disabled, or deleted.Selecting a layer and clicking the “Edit” button

allows you to configure display parameters and modify the layer name.If a DXF or hand-drawn graphic file is imported, the editing interface will resemble Figure 4.7.1-4. You can view the number of graphic elements within the layer and set filters to display specific types of elements.If a shape file is imported, the editing interface will resemble Figure 4.7.1-5. If attribute data is detected from the associated attribute file (*.dbf), you can configure the display of attribute content by selecting the desired fields from the dropdown list.Shape files can read three types of graphic elements: points, lines, and polygons. Figure 4.7.1-6 illustrates a polygon graphic.

Generally, a shape file consists of three files with the same name: the shape file (.shp), the attribute file (.dbf), and the index file (*.shx).The software does not read the index file when importing a shape file. If the attribute file exists, it will be read. When reading the shp file, you need to select the coordinate format for import: Geographic coordinates (degrees) or planar coordinates (meters).

Tip: You can also import base maps through the [Import/Export] feature on the project page.

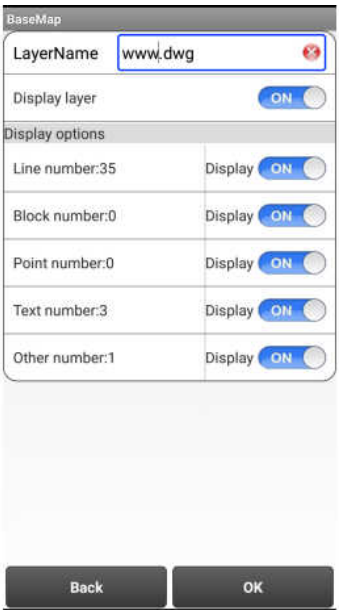


Figure 4.7.1-4

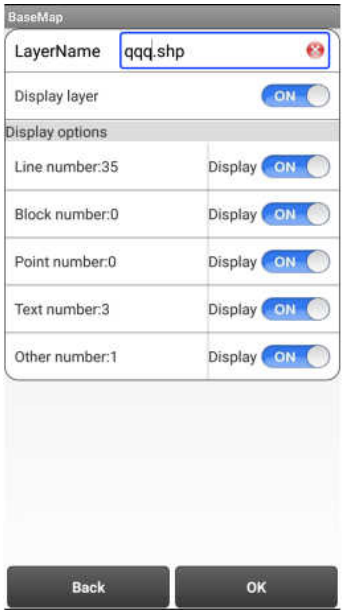


Figure 4.7.1-5

Figure 4.7.1-6

Tip: It is common to encounter situations where measurements need to be taken in an area over several days. After completing the measurements on the first day, you return to the office and draw the map for that day. If you create a new project on the second day for further measurements, there won't be yesterday's base map on the screen. This lack of reference can make it difficult to have a comprehensive

understanding of the measurement area and may result in duplicated work. However, if you continue the measurement in the previous day's project instead of creating a new one, the graphics already processed during the first day's office work will be mixed with the newly collected data. This will require deleting the drawn graphics, which can be quite troublesome.The best approach is to import the previous day's graphics as a base map into the current day's project. When exporting the DXF graphic, only the newly surveyed data should be exported, and the base map should be excluded. To import the graphics from the previous day, you can import the processed office graphics (DWG or DXF) or directly import the graphics from the previous project (GSC), as shown in Figure 4.7.1-7. Select the hand-drawn graphic file (*.gsc), click on "Previous Layer," and locate the graphical data from the previous project (either the original file or backup file can be selected) to import as a base map.

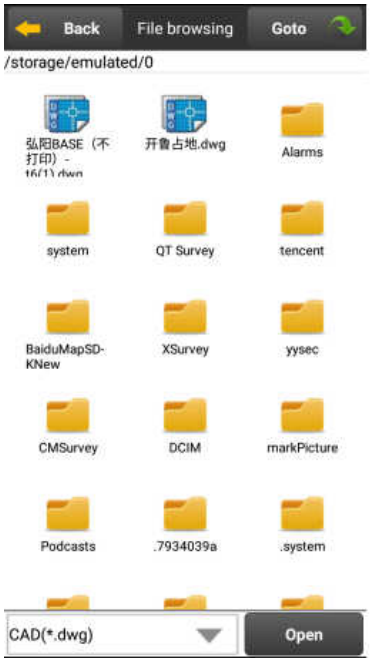


Figure 4.7.1-7

Importing image files requires attention.

（1） Importing image files (tif) requires an accompanying image coordinate information file (tfw). The tfw file should have the same name as the corresponding tif file and be placed in the same directory as the source file. For example:

image.tif

image.tfw

（2） When importing image files (jpg), an accompanying image coordinate information file (jgw) is required. The jgw file should have the same name as the corresponding jpg file and be placed in the same directory as the source file. For example:

image.jpg

image.jgw

（3）Only one image or picture file can be imported for each project, and importing again will replace the previous one.

2、Road measurement setup.

[Real-time Mileage] Select whether to display real-time mileage, which is only shown during line layout or road layout. It dynamically displays the mileage and offset of the current point relative to the route next to the current point.

[Display Cross-section Points] Displays the points measured for road cross-sections.

[Road Auxiliary Point Mileage] Displays the positions and mileage of auxiliary points (such as tangent points, circular points, midpoint of curves, etc.) on the layout line.

3、Power measurement setup.

[Display Power Points] Displays power measurement points.

[Display Foundation Points] Displays the foundation positions of all poles or towers.

[Display Tower Foundation Cross-Section Point] indicates the cross-sectional point of power measurement for the tower foundation.

4.7.2 Drawing Settings

[Object Snap Settings]

[Endpoint] captures each point of a polyline or a line segment, usually set to ‘On’.

[Midpoint] is the midpoint of each line segment or straight line in a polyline.

[Center] captures the center of a circle.

[Node] captures the positions of measurement points, layout points, and control points, usually set to ‘On’.

[Perpendicular Point] captures the perpendicular points on polylines and straight lines.

[Closest Point] captures the closest points on polylines, straight lines, and circles.

[Intersection] captures the intersection points of polylines and straight lines.

[Quadrant Point] captures the four quadrant points on a circle.

[Freehand Line] captures the nodes of freehand lines, which are usually used as rough auxiliary drawing lines for sketching and annotating. It is typically set to be turned off.

[Reference Block] captures every entity within the reference block, rather than capturing the insertion point of the reference block itself. The reference block serves as a symbol for drawing purposes and generally does not require capture.

[Background Image] captures entities on the imported background image and is typically set to be turned off.

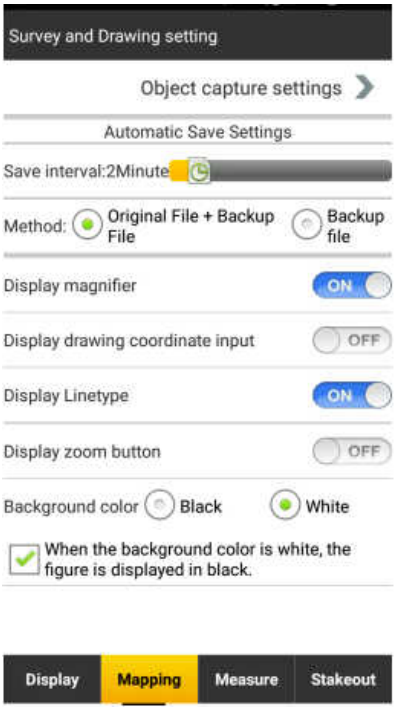


Figure 4.7.2-1

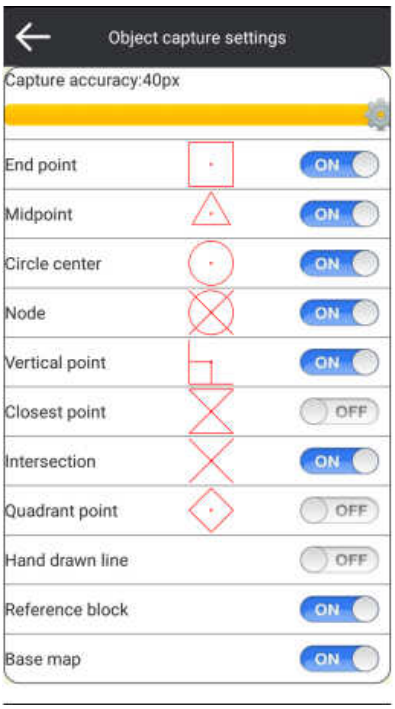


Figure 4.7.2-2

[Snap Precision] refers to the distance between the touch point on the touch screen and the snap point. Objects are captured when the distance is less than the specified pixel unit. Use the scroll bar to set the snap precision, with a range of 0~40px. Setting it to 0 disables object snapping. When the snap precision is set to the maximum, it is easier to capture points while drawing with a finger.

Tip: When the targets to be snapped are relatively dense, it is recommended to zoom in on the graphics before capturing.

[Auto Save Interval] Graphics files are automatically saved at specified time intervals. Set an appropriate save time interval to prevent data loss in case of

forgetting to save the graphics before exiting the program. Use the scroll bar to set the save time interval, which can range from 1 to 20 minutes. The auto save feature cannot be disabled. Each time an auto save occurs, the auto save icon will briefly appear in the upper right corner of the screen .

[Auto Save Mode]

Original File + Backup File: Automatically save graphic data to the original file and backup file of the project. The graphic filename is the same as the project name with the extension .gsc, and the backup file is named by adding '_Backup' after the original filename.

Backup File: Automatically save graphic data to the project's backup file.

Tips:

1、When an external SD card is inserted, saving the backup file will also save a copy of the graphic file onto the external SD card. The save directory will be the same as the project's folder directory.

2、In the case of selecting to only save the backup file, if the program is closed without saving the graphic or if an abnormal exit occurs causing the graphic to not be saved, you can go to Data > Import/Export > Graphics > Import. Select the file format as Handheld Graphic File (*.gsc) to import the backed-up file into the original project file.

3、In the case of selecting to only save the backup file, you need to manually save the graphic file by clicking the save button on the bottom toolbar.

[Display Magnifier] When drawing on the touch screen, the magnified image of the current touch point is displayed in the upper left corner of the screen. This allows you to use the magnifier to view the graphic underneath your finger and check if the object is being captured.

[Display Linetypes] Some complex lines with properties, such as hatches, ramps, etc., have linetypes. They are displayed when the drawing is zoomed to a certain extent, and it is generally enabled when measuring and drawing. After drawing a complex line, you can change the direction of the linetype.

Tip: When ending a complex line, long-pressing the [End] or [Close] button will

allow you to complete the line and change its direction.

[Drawing Scale] The setting of the scale involves the size of symbols and the width of the complex lines (some of which have properties). The smaller the scale, the larger the symbols. The following commonly used scale options are available: 1:500, 1:1000, 1:2000, 1:5000, 1:10,000, 1:25,000, 1:50,000, 1:100,000.

Modifying the scale here does not affect the size of symbols that have already been drawn. When exporting a DXF file, the drawing scale in CASS is the same as the scale set here! The size of symbols and the scale can also be uniformly modified in CASS.

[Display Zoom Buttons] Display zoom buttons on the graphic interface, usually set to 'Off', allowing two-finger touch to zoom in/out on the graphics.

4.7.3 Measurement Settings

The measurement settings include general measurement settings and road measurement settings, as shown in Figure 4.7.3-1.

Figure 4.7.3-1

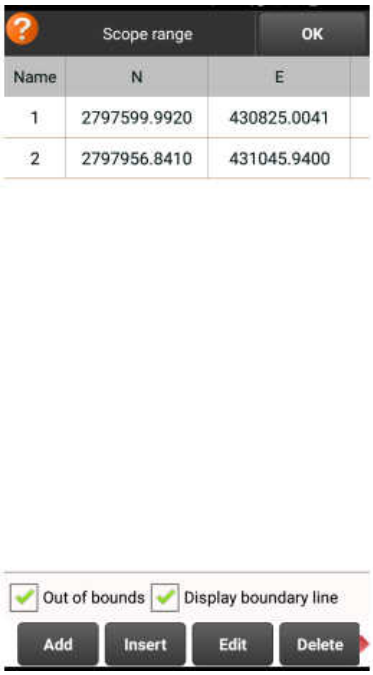


Figure 4.7.3-2

[Measurement Point Information Form] If enabled, when measuring individual points on the graphic interface, a measurement point information form will pop up. If disabled, points will be directly saved without being displayed.

[Enable Tilt Correction] Under low precision requirements, the receiver can

measure within a tilt range of 30 degrees from the vertical mast. The program will correct the receiver's coordinates to the ground point, achieving positioning accuracy within 5cm. When using tilt measurements, the receiver must be in a stationary state.

[Tilt Limit without Tilt Correction] When tilt correction is not used, a reminder will be given if the tilt of the vertical mast is too large. A specific angle limit will be set.

[Fixed Solution Audio Alert Interval] When not in a fixed solution state, if the elapsed time exceeds the set interval, an audio alert will be sounded upon suddenly acquiring a fixed solution. The interval should not be less than 5 seconds.

[Solution Type] The limitation of the solution types for point acquisition includes: (Fixed Solution, Float Solution, Code Differential, Wide Area Differential, Single Point). For example, when the solution type is limited to Fixed Solution, data acquisition will only proceed without popping up the accuracy prompt if it is in the RTK Fixed Solution state and both the horizontal and vertical accuracies are within the given limits. (When the current solution type matches the limited solution type, a comparison with the horizontal and vertical accuracies beyond the limits is necessary. If the current solution type is superior to the limited solution type, no comparison with the horizontal and vertical accuracies is needed.)

[Horizontal Accuracy] The horizontal positional error of the measurement point. Input the maximum error tolerance value. During point acquisition, if the error exceeds the specified value, a dialog box will prompt the error limit exceeding.

[Vertical Accuracy] The vertical positional error of the measurement point. Input the maximum error tolerance value. During point acquisition, if the error exceeds the specified value, a dialog box will prompt the error limit exceeding.

[Setting Measurement Area Range] You can set the boundary lines for the measurement area and enable notifications when exceeding the boundaries, as shown in Figure 4.7.3-1.

The measurement area boundary lines can be manually added by inserting boundary points or imported from a file.

The 'Add' function allows you to add a point. You can enter the coordinates manually, select a point from the point library list, or choose a point on the graph.

Each time a point is added, the program automatically saves it to the current project.

The 'Insert' function allows you to insert a point after a specified point, same as the method of adding points.

The 'Edit' function allows you to long-press and select a point to edit its coordinates.

The 'Delete' function allows you to long-press and select a point to delete it.

The 'Save' function allows you to save the boundary line to a separate file (.fwx).

The 'Load' function allows you to load boundary line data from a file (.fwx) or a DXF file.

Note: The loaded DXF file must contain only one closed polyline, and the boundary line must have at least 3 points.

The 'Out-of-Bounds Alert' feature will display a warning message in the center of the screen when the measured area exceeds the boundary line, as shown in Figure 4.7.3-3.

Whether to display the boundary line on the graph.

Note: After performing actions such as adding points, loading data, or selecting options, you must click the 'OK' button for the changes to take effect! The boundary line is saved within the project file and automatically loaded every time the project is opened.

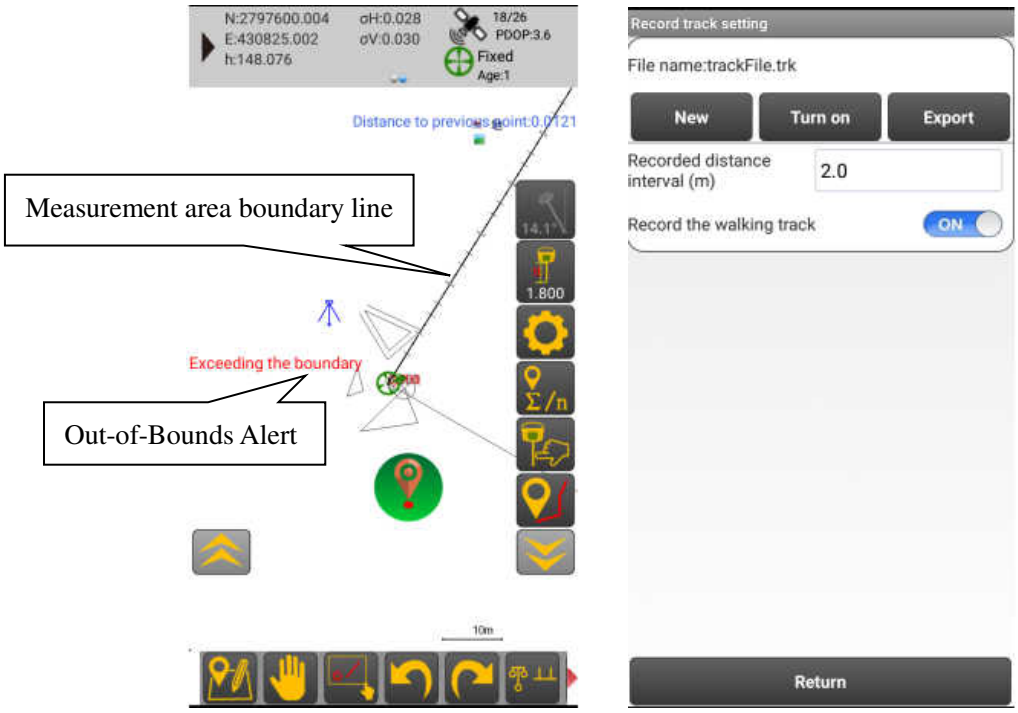
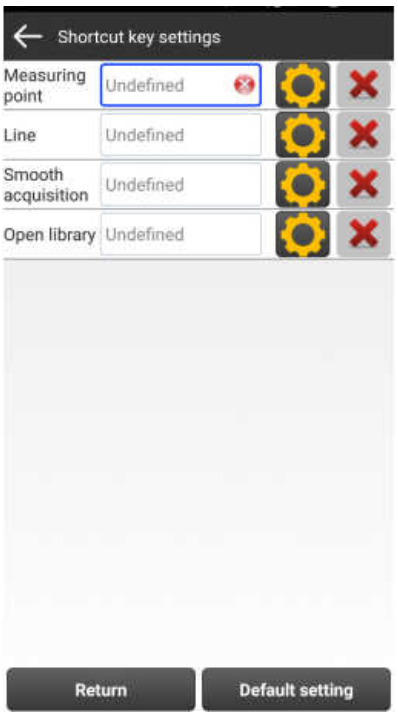


Figure 4.7.3-3 Figure 4.7.3-4

[Record Walking Trajectory] Click the[Settings] button to configure the trajectory. Please refer to Figure 4.7.3-4. When the distance between the current point and the previous point exceeds the set distance interval, save the current coordinates to the trajectory file. The trajectory coordinates record latitude, longitude, and elevation. You can create a new trajectory file (.trk) or open an existing one. The default file name is trackFile.trk. The walking trajectory can be viewed on Baidu Maps. The trajectory data can be exported in CAD format (dxf), South CASS coordinate file (dat), spreadsheet file (csv), or kml file (*.kml). Set 'Record Walking Trajectory' to 'ON' in order to record the data.

[Shortcut Key Settings] Set the physical buttons of the device as shortcut keys for measuring and other functions, for example, setting the volume keys as shortcuts for measuring points and lines, as shown in Figure 4.7.3-5. Click the corresponding button for the function to open a dialog box, as shown in Figure 4.7.3-6, then press the desired physical button to complete the setup. Click the button to delete the set shortcut keys. The "Default Settings" button restores the default shortcut key settings.



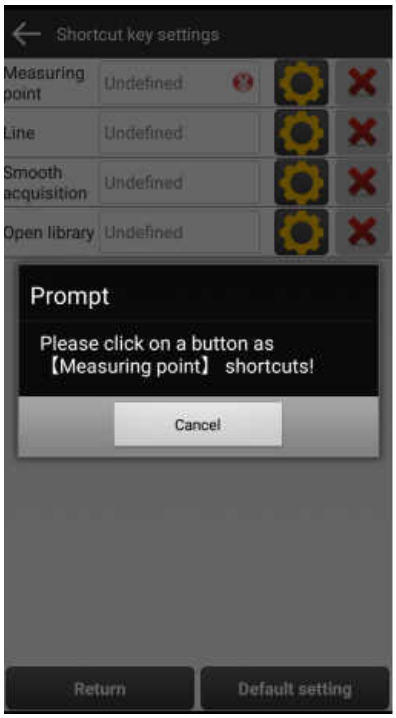


Figure 4.7.3-5 Figure 4.7.3-6

[Cross-Section Distance Tolerance] During cross-section collection, a prompt "Approaching Cross-Section" will appear when the distance from the current point to the cross-section reference line is less than this value.

4.7.4 Setting Out Configuration

[Layout Point Order] When selecting the next layout point during point layout, the layout points are incremented to the next point in either ascending or descending order.

[Alignment Direction Prompt] During alignment layout, the walking direction is indicated, which can be in the forward, backward, leftward, or rightward direction (forward: towards larger mileage, backward: towards smaller mileage, towards the left or right of the alignment direction), or indicated in the compass directions (east, west, north, or south).

[Repeat Layout] During point layout, if repeat layout is disabled, selecting the next layout point or selecting the nearest layout point will skip the points that have already been laid out. When enabled, previously laid out points can still be reselected.

[Display Modify Point Dialog when Layout Point is Completed] During point layout, when entering the layout point area and clicking the "Complete Layout" button, a dialog box will pop up for modifying the layout point, providing convenience for adding remarks or modifying the point number.

[Layout Fine-tuning Radius] The fine-tuning radius is the range within which the display switches to fine-tuning mode when the receiver enters. By referring to the scale on the diagram, the receiver can be moved to the layout point. The fine-tuning radius can be adjusted within the range of 0.1 to 1 meter based on different layout precision requirements.

When entering the layout area, three concentric circles will be displayed. The smallest circle represents the fine-tuning zone, while the largest circle represents the layout prompt zone.

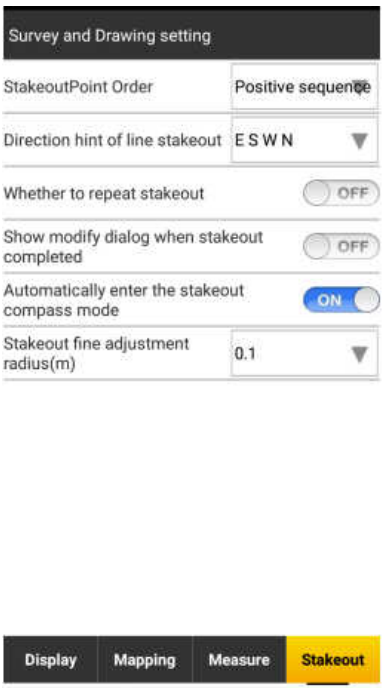
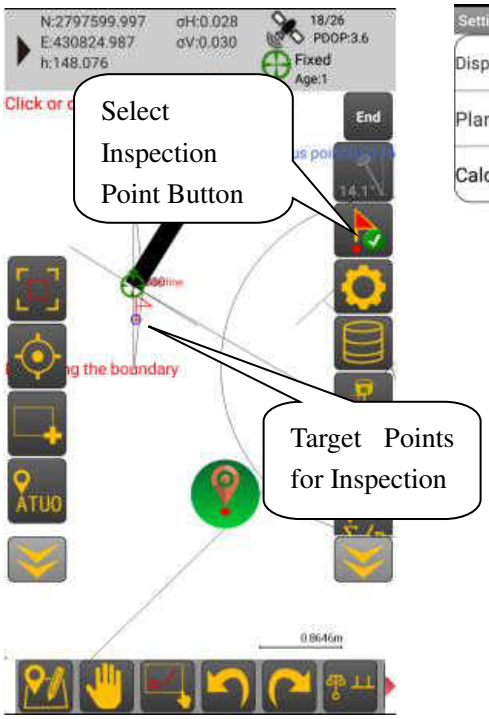


Figure 4.7.4-1

4.8 Quality Inspection Measurement

Quality Inspection Measurement is primarily used to verify the accuracy of existing terrain maps and coordinate points, and export accuracy statistics tables. The usual process involves importing a pre-drawn terrain map as a base map, specifying the points to be inspected on the map, and then using an instrument to measure the coordinates of these points on-site. By comparing the existing coordinates with the measured coordinates, the statistical accuracy can be determined.

1、Click the “Select Point” button , when the button is checked , you can specify the location of the inspection point on the diagram by capturing the designated point using object snapping, as shown in Figure 4.8-1.



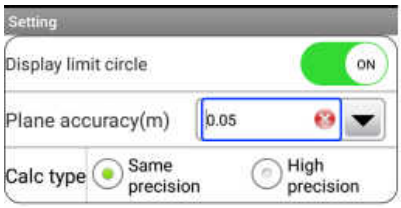


Figure 4.8-1 Figure 4.8-2

2、Click the “Settings” button to enable or disable the display of tolerance circles on the diagram, as shown in Figure 4.8-2. By setting the tolerance value for planar accuracy, a circle with a radius equal to the tolerance value will be displayed at the inspection point position on the diagram. If the measured coordinates fall within this circle, they are considered acceptable. The calculation method for the mean error differs for precision testing and high-precision testing, using different formulas for the final calculation of the mean error.

3、When the inspection points have been specified (indicated by red flags on the diagram), click the [Measure Point] button to collect coordinates for inspection. A measurement point information form will pop up, as shown in Figure 4.8-4.

Note: If you click the “Measure Point” button without specifying inspection points, it will only collect regular measurement points.

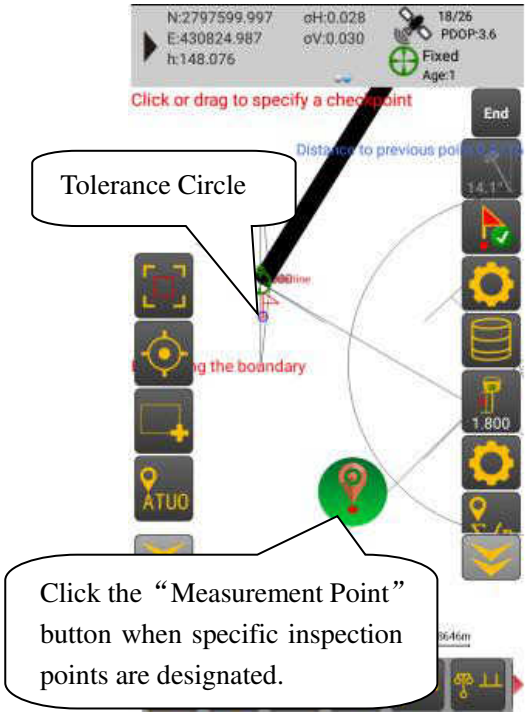


Figure 4.8-3

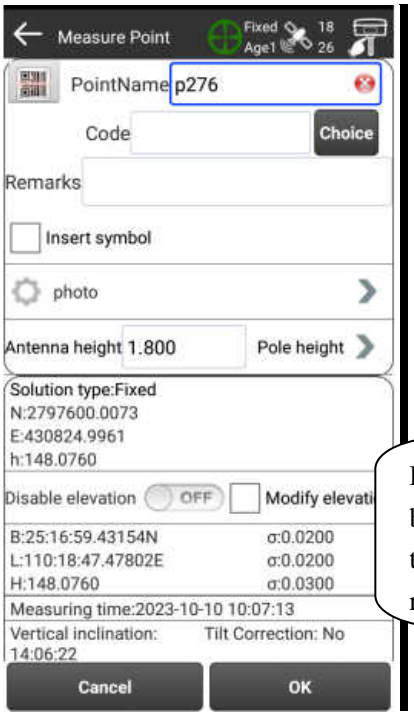


Figure 4.8-4

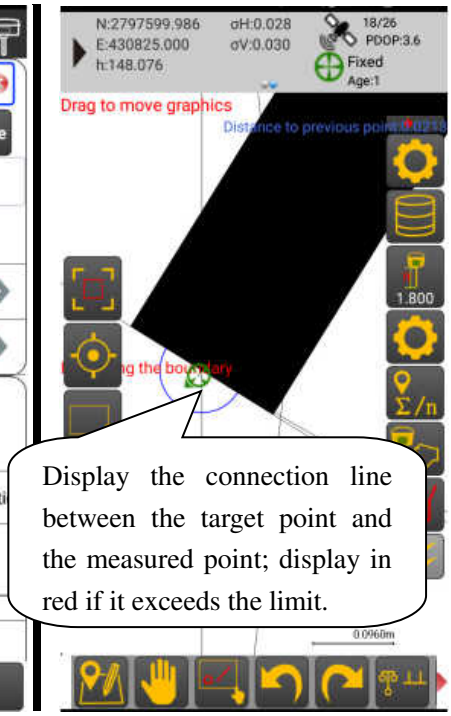


Figure 4.8-5

4、Click the List button to view the measured inspection data, the coordinate differences for each point, as shown in Figure 4.8-6.After completing the measurements, you can export the inspection data as an Excel spreadsheet: on the Project page - Import/Export - Export Measurement Points, select "Coordinate Check Table (*.xls)", as shown in Figure 4.8-7.

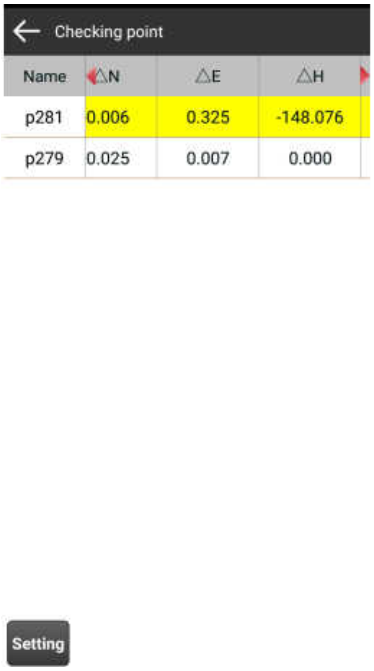


Figure 4.8-6

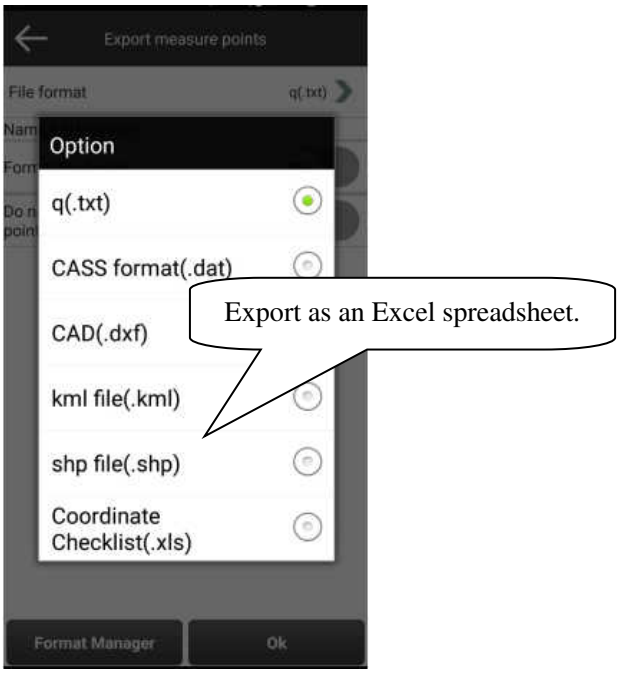


Figure 4.8-7

Chapter V. Road Measurement

Select “Road Measurement” on the measurement page of the main interface as shown in Figure 5-1, which includes road layout, road alignment, and cross-section acquisition.

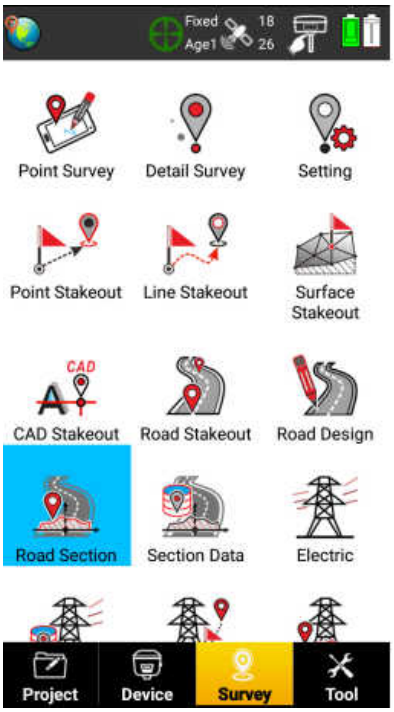


Figure 5-1

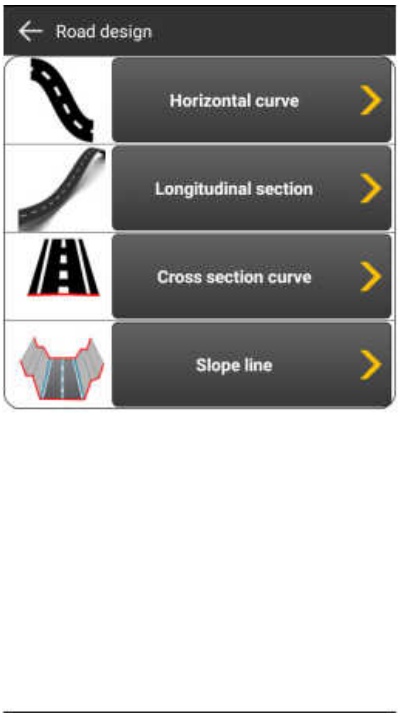


Figure 5-2

5.1 Road Alignment.

Click [Road Alignment] to enter the road design interface as shown in Figure 5-2, which includes horizontal profile design, vertical profile design, cross-section design, and slope line design.

5.1.1 Horizontal Profile Design.

Horizontal Profile Design offers two methods: Intersection Method and Line Element Method (also known as Block Method). The Intersection Method is based on defined rules where intersecting points are combined in a transition-curve-circular-curve-transition manner, which imposes certain restrictions

on the curve expression. On the other hand, the Line Element Method allows for arbitrary combinations of route shapes, even for complex curves such as egg-shaped curves. To obtain line element data for multi-intersection curves, interchange point tables, or virtual intersection points, the corresponding auxiliary software is required for data conversion, and then line element method is used for line determination.

Intersection Method.

Users only need to input the coordinates of the intersection points of the route curve, as well as relevant information such as transition curve length, radius, and mileage for the corresponding route. In this way, they can obtain the coordinates of key points, stationing points, and route points, along with a visual graphical display. This facilitates the measurement tasks, such as route layout, in a convenient manner. The interface of the Intersection Method is shown in Figure 5.1.1-1.

[Add] Add intersection data by entering parameters including intersection name, N, E, intersection mileage, arc radius, length of the first transition curve, length of the second transition curve, as shown in Figure 5.1.1-2. Repeat the process of adding until all intersections have been added.

The first and last intersection points do not require the input of transition curve lengths, radius, and arc radius. Only the first intersection point needs to input the mileage, and the mileages of the remaining points will be automatically calculated based on the curve length.

Prompt: Long press to select a record for options such as delete, edit, and insert.

[Preview] At least 3 intersections need to be added in order to preview the designed curve, as shown in Figure 5.1.1-3. In the preview window, you can input mileage and offset to calculate coordinates (indicated by the red flag on the diagram), or calculate mileage and offset based on coordinates. The calculation function is used to verify the accuracy of coordinates for specified mileages, as shown in Figure 5.1.1-4.

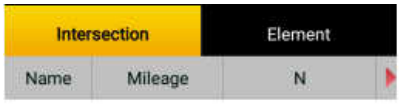


Figure 5.1.1-1

Figure 5.1.1-2

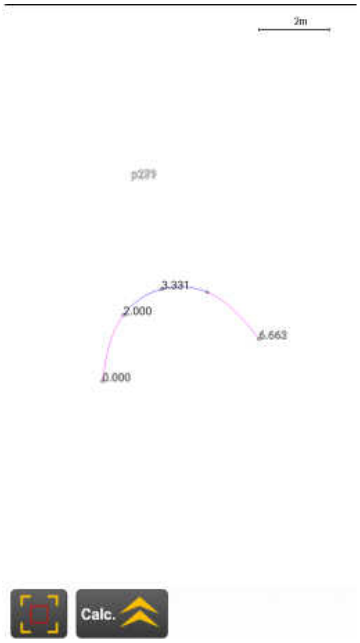
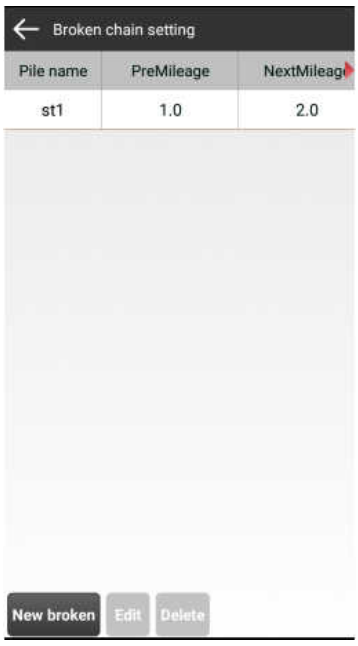


Figure 5.1.1-3

Figure 5.1.1-4

[Chain Break] Set mileage chain break data, as shown in Figure 5.1.1-5. Click on [New Chain Break] to open the add chain break interface, as shown in Figure 5.1.1-6. Enter the chain break data and click on [Confirm] to create a new chain break. The program will automatically determine if it's a long chain or a chain break. Selecting a chain break allows for editing and deleting operations. When chain break data is set, the chain break button icon will be displayed as " ". When checking mileage or during

layout, the mileage between short chains (discontinuous mileages) will not exist, and a prompt of non-existent mileage will be displayed, as shown in Figure 5.1.1-7. For mileages between long chains (duplicate mileages), there will be a prompt to select the mileage before the chain break or the mileage after the chain break.



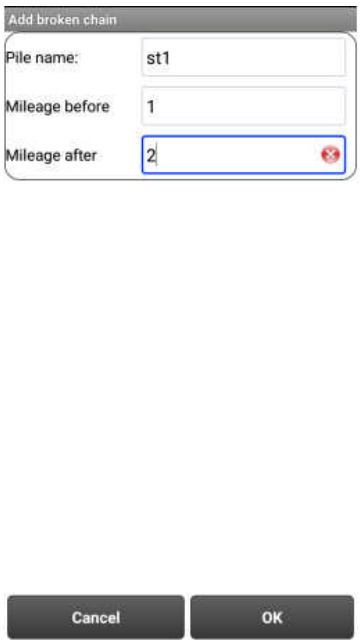


Figure 5.1.1-5 Figure 5.1.1-6

Figure 5.1.1-7

[Enable] Load the road curve data obtained from the current intersection method into the program for road layout and cross-section measurement. After enabling, this

curve will be displayed in the graphical interface of road layout and cross-section measurement.

[Load] Open a pre-edited intersection file (*.poi). Intersection files can be manually inputted and saved as .poi files using a text editor like Notepad. Import the file into the handheld device. Loading only displays the intersection file, and it can only be applied to the current project after clicking on [Enable]

[Save] Save the current inputted intersection data to a file (*.poi).

[Detailed Information] can display the detailed curve elements of the route, as shown in Figures 5.1.1-9, 5.1.1-10, and 5.1.1-11. It includes three pages: Intersection Table, Line Element Table, and Main Point Inspection. You can view values such as turning angle, curve length, tangent length, and main point coordinates.

Intersection	Element	Main point
Name	Mileage	N
p282	0.0000	2797962.0069
p276	413.6790	2797600.0073

Intersection	Element	Main point
Line type	N	E
Straight line	2797962.0069	431025.1325
Straight line	2797599.9876	430824.9930

Intersection	Element	Main point
Line type	Mileage	N
HZ	433.6590	2797599.9876

Figure 5.1.1-9 Figure 5.1.1-10 Figure 5.1.1-11

Line Element Method.

Line Element Method is a commonly used approach in road design. It involves dividing the road alignment into various road basic elements such as straight lines, transition curves, and circular curves. Following certain rules, these basic elements are systematically added and combined to create the entire road alignment, achieving the goal of designing the entire road segment.

The line elements can be manually entered or imported from a file (*.elm). Please refer to the appendix of the manual for the specific format.

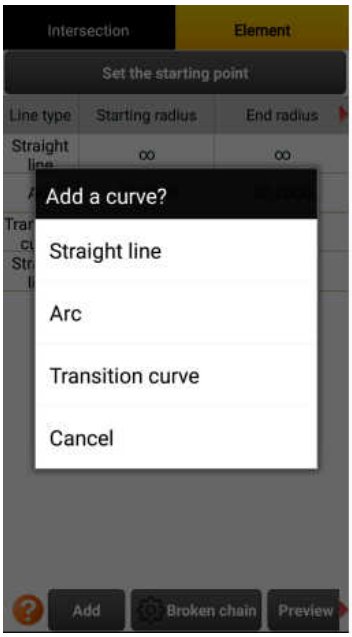


Figure 5.1.1-12 Figure 5.1.1-13 Figure 5.1.1-14

[starting point] Firstly, it is necessary to input the starting coordinates, distance, and azimuth, as shown in Figure 5.1.1-13.

[Add] After setting the starting point, you can begin adding line elements, as shown in Figure 5.1.1-14.

Straight Line: Simply enter the line length, as shown in Figure 5.1.1-15.

Arc: Input the radius, arc length, and deflection (the deviation direction with reference to the forward direction), as shown in Figure 5.1.1-16.

Transition Curve: Enter the starting radius, ending radius, curve length, and deflection, as shown in Figure 5.1.1-17.

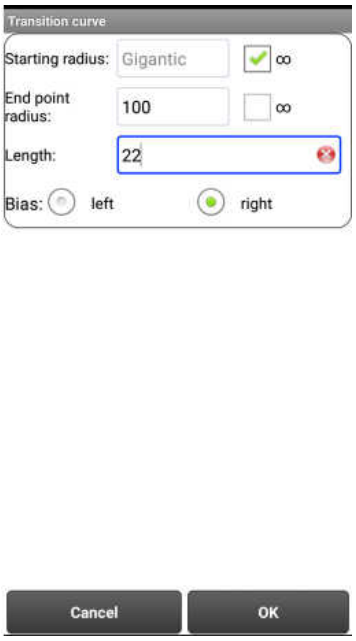


Figure 5.1.1-15 Figure 5.1.1-16 Figure 5.1.1-17

Tip: Long-press on a specific record to perform delete, edit, or insert operations.

[Chain Disruption] Please refer to the intersection method for chain disruption settings.

[Preview] Check if the curve is correct in the preview window, as shown in Figure 5.1.1-18. You can input mileages to calculate coordinates and tangent azimuth, or you can calculate mileages by reverse calculating coordinates. The calculation function is used to verify the correctness of coordinates for the specified mileages.

[Enable] Load the road curve data obtained from the current alignment method into the program, used for road layout and cross-section measurement. After enabling, this curve will be displayed in the graphical interface of road layout and cross-section measurement.

[Load] Open a pre-edited alignment file (*.elm). The alignment file can be manually input using a text editor and then saved with the '.elm' extension. Import it into the notebook from the file, as shown in Figure 5.1.1-19.

[Save] Save the currently inputted alignment data to a file (*.elm).

[Detailed Information] Displays the detailed curve elements of the alignment, as shown in Figure 5.1.1-20. The alignment method includes 'Alignment Table' and

‘Main Point Check,’ where you can view parameters such as alignment type, length, and coordinates of characteristic points.

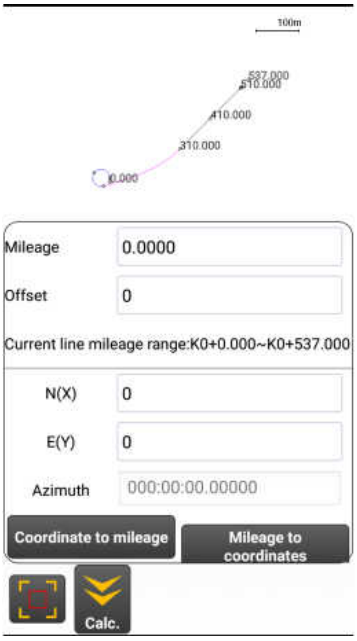


Figure 5.1.1-18

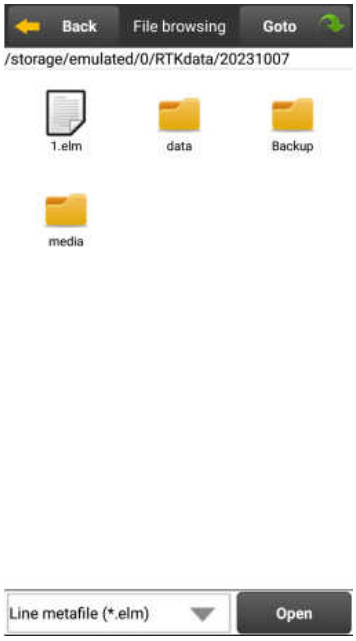


Figure 5.1.1-19

Line type	N	E
Straight line	2797599.9876	430824.9930
Arc	2797609.9876	430824.9930
Transition curve	2797590.8091	430810.6662
Straight line	2797677.5374	430988.4238
Straight line	2797748.4044	431058.9778
Arc	2797819.2714	431129.5318
Transition curve	2797822.9851	431132.8766

Figure 5.1.1-20

5.1.2 Longitudinal Section Design

Longitudinal section refers to the curve that represents the vertical variation of a road. The alignment’s longitudinal section curve can be manually entered or imported from a file (*.pov).

[Add] Adding a grade change point includes mileage, elevation, longitudinal curve radius, and ‘Grade Ratio 1’ and ‘Grade Ratio 2’ will be calculated automatically.

Tip: Long-pressing on a selected record allows you to perform deletion, editing, and insertion operations.

[Preview] To preview the designed curve, at least 3 grade change points need to be added. In the preview window, you can check if the curve is correct. You can calculate the elevation of specified points by entering the mileage, as shown in Figure 5.1.2-3.

[Enable] Load the designed longitudinal section curve data into the program, which can be used for elevation layout in the layout interface.

Figure 5.1.2-1

Figure 5.1.2-2

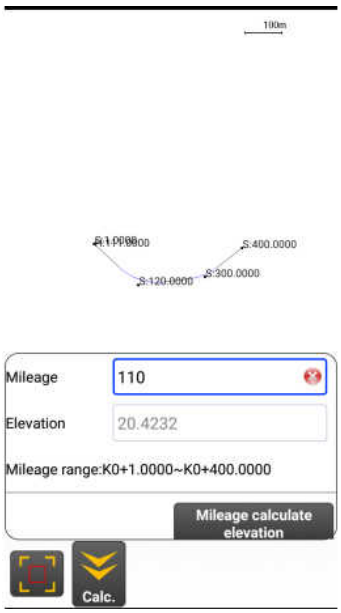


Figure 5.1.2-3

Figure 5.1.2-4

Figure 5.1.3-1

Figure 5.1.3-2

[Load] Open a pre-edited longitudinal section file (*.pov). The longitudinal section file can be manually entered and saved with the .pov extension using Notepad. Import it into the handheld device from the file, as shown in Figure 5.1.2-4.

[Save] Save the currently inputted grade change point data to a file (*.pov).

5.1.3 Cross-Section Design

[Add] Add cross-section feature points, select to add points on the left or right side. Two input methods for slope ratio are available here: percentage or ratio, as

shown in Figure 5.1.3-2.

Name: The name of the current module, which can be selected from the dropdown list.

Width: The horizontal distance from the previous grade change point.

Slope: The ratio of the height difference between the current point and the previous grade change point to the horizontal distance between the current point and the previous grade change point.

Road Kerb: The height difference between the current module and the previous module.

[Symmetrical] Checking this option indicates that the left and right slopes are identical. The data for the right slope will be replaced with the data from the left slope. When adding a point after checking this option, both the left and right grade change points will be increased simultaneously.

Long-pressing the data item in the list allows you to perform operations such as "Width Increase," "Over Height," editing, and deletion on the selected module, as shown in Figure 5.1.3-3.

[Width Increase] Enter the width increase settings interface as shown in Figure 5.1.3-4. Click on [Add] to enter the width increase creation interface as shown in Figure 5.1.3-5. You can input the mileage, width, and select the gradient mode (linear gradient, cubic parabolic, quartic parabolic). Editing and deleting operations can be performed on selected data."

[Over Height] Enter the over height settings interface as shown in Figure 5.1.3-6. Click on [Add] to enter the over height creation interface as shown in Figure 5.1.3-7. You can input the mileage, gradient, and select the gradient mode (linear gradient, cubic parabolic). Editing and deleting operations can be performed on selected data.

After setting the width increase and over height, the corresponding module will be marked with the icon, as shown in Figure 5.1.3-8.

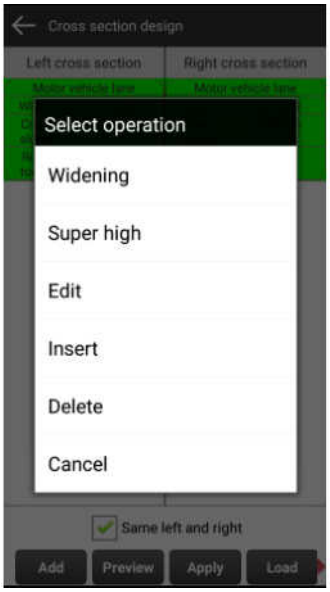


Figure 5.1.3-3

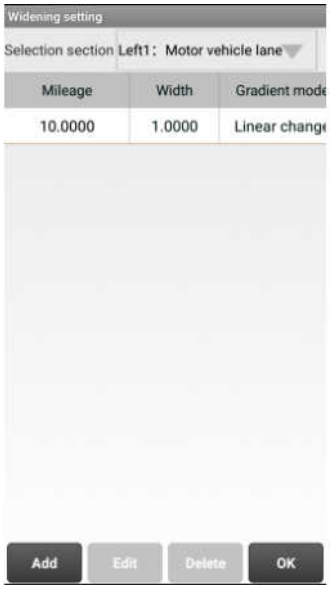


Figure 5.1.3-4

Figure 5.1.3-5

Figure 5.1.3-6

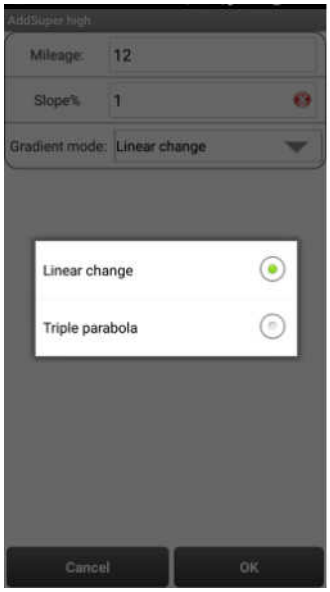


Figure 5.1.3-7

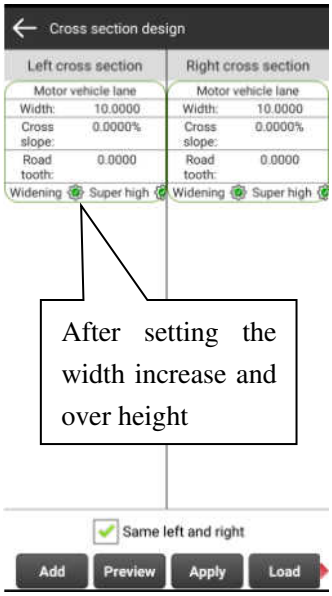


Figure 5.1.3-8

[Preview]View the cross-sectional line in the preview window to check its accuracy, as shown in Figure 5.1.3-9. In case of over height or width increase, you can view the corresponding cross-sectional diagram by entering the mileage.

[Enable] Load the current design cross-sectional data into the program for layout purposes.

[Load] Open an already edited cross-sectional file (*.crs). The file can be manually entered using a notepad and saved with a modified extension as .crs. Import it into the notebook from the file, as shown in Figure 5.1.3-10.

[Save] Save the currently inputted data to a file (*.crs).

Note: Only one cross-sectional profile can be enabled at a time. Different road segments of a single road may have varying cross-sectional profiles. To use, define multiple cross-sectional profiles in advance and load the appropriate cross-sectional profile design line for the specific terrain during layout.

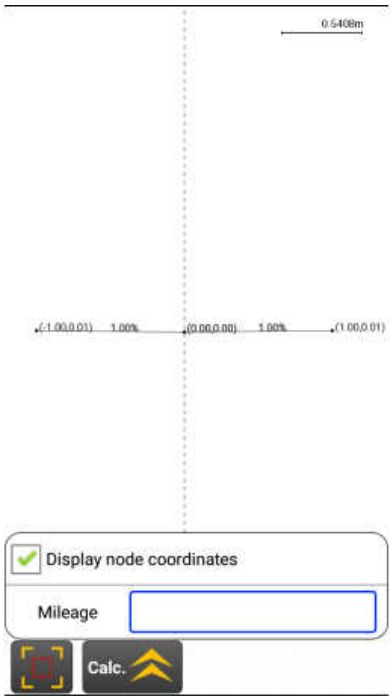


Figure 5.1.3-9

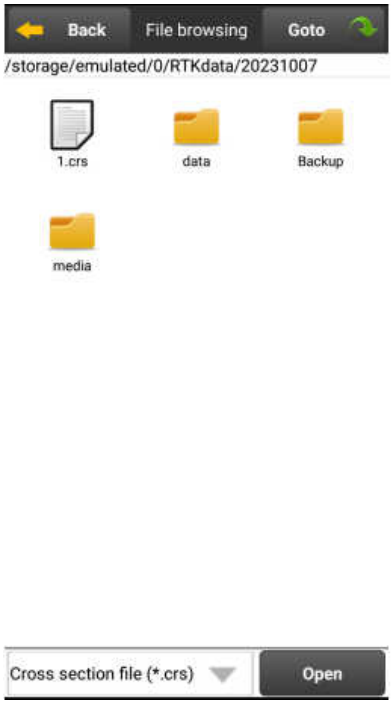


Figure 5.1.3-10

5.1.4 Slope Line Design.

After entering the slope interface, click the [Add] button to open a dialog box as shown in Figure 5.1.4-1. Enter the slope name, select the excavation or fill, and click [OK and Edit] to enter the editing interface as shown in Figure 5.1.4-2. You can create new slopes, platforms, and ditches.

Figure 5.1.4-1 Figure 5.1.4-2 Figure 5.1.4-3

[Create New Slope] as shown in Figure 5.1.4-3, input the name, slope height, and slope ratio.

[Create New Platform] as shown in Figure 5.1.4-4, input the name, width, and cross slope.

[Create New Ditch] as shown in Figure 5.1.4-5, input the name and parameters such as ditch height and width. There are two types of ditches: rectangular ditches and trapezoidal ditches.

Long press on a data item to edit and delete.

[Preview] allows you to preview the slope diagram, as shown in Figure 5.1.4-6.

Figure 5.1.4-4 Figure 5.1.4-5 Figure 5.1.4-6

[Enable] loads the slope library data of the current design into the program for layout purposes.

[Load] opens a pre-edited slope library file (*.bps).

[Save] saves the current slope data to a file.

Design slope data for different mileages and load the corresponding slope data for layout purposes during slope layout.

5.2 Road Layout

The concept of road layout is similar to that of line layout. First, define the line and then input the mileage to specify the position of layout points. The only difference is that road layout involves a slightly more complex line design, which includes the definition of longitudinal and transverse profile lines.

The road layout interface is shown in Figure 5.2-1. Before conducting road layout, it is necessary to load the road design lines (horizontal profile, longitudinal profile, and cross-section). Click the [Line Library] button to open the interface for loading design lines, as shown in Figure 5.2-2. The Load button can open the corresponding design line file and automatically enable the selected line. You can preview the graphics to ensure their correctness. The “Clear” button can remove any imported lines.

If only the horizontal profile lines are loaded, the elevation layout will be ignored. Only when both the longitudinal profile and cross-section lines are loaded, the elevation layout data will be calculated.

[Click here] to enter the sampling point setup interface, as shown in Figure 5.2-3. You can input the mileage of the points to be surveyed. The mileage and offset will automatically accumulate based on the increments. Please refer to the method of line layout. When encountering long chains with breaks, you need to choose the

mileage before or after the break.

Note: When selecting the next sampling point, the software will automatically determine whether it encounters feature points (such as tangent points, curve points, etc.). If feature points are encountered, they will be used as the layout points.

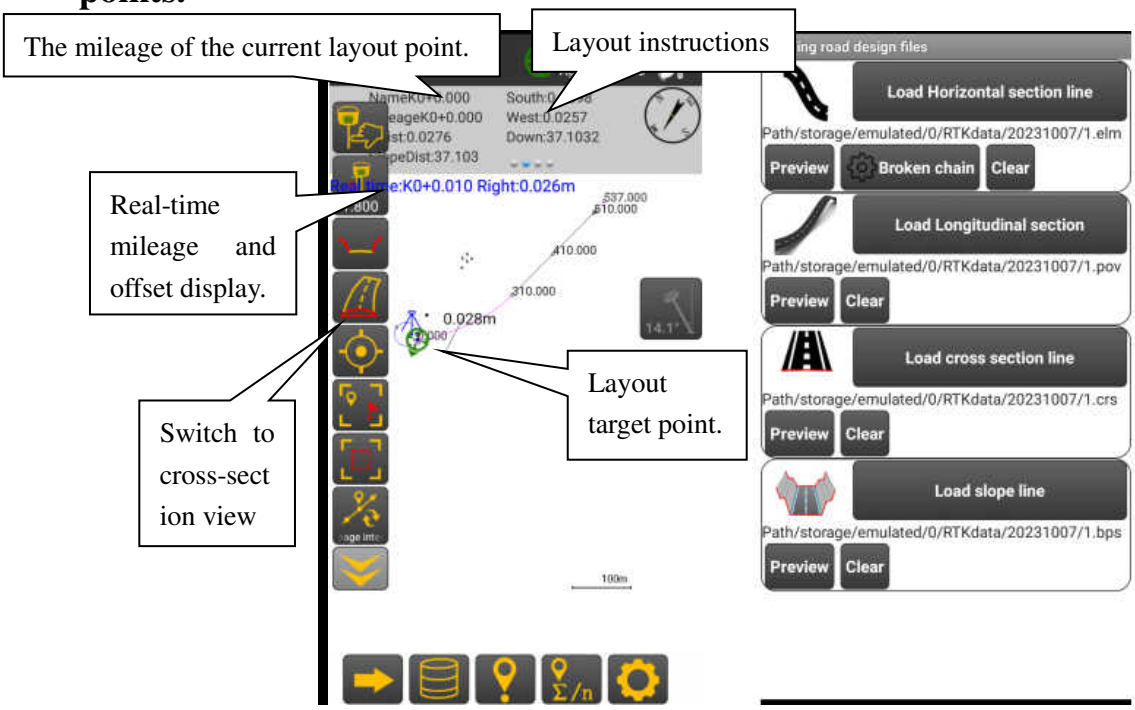


Figure 5.2-1 Figure 5.2-2

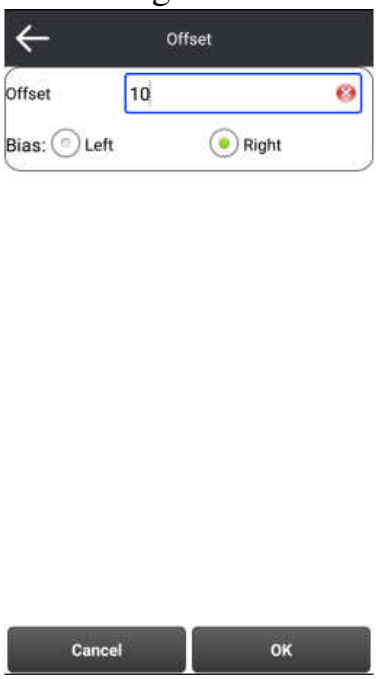


Figure 5.2-3 Figure 5.2-4

The term ‘offset’ (offset) is commonly used when placing boundary markers during layout. Selecting the ‘offset direction’ (offset direction) as ‘left’ or ‘right’ respectively represents the left or right side of the line. The offset is the distance from the centerline to the boundary line. Setting the increment to 0 allows you to place the boundary marker at the specified mileage.

[Zoom] Scale the current point and the projected point to be displayed at the center of the screen.

Layout Process

The specific layout point-finding process is the same as the method used for point layout, as shown in figure 5.2-4. Please refer to point layout or line layout.

Tip: You can enable the real-time mileage feature in the display settings. The software will project the current location point onto the route (represented by a small dot on the route), and display in real-time the line connecting the current point to the projected point, as well as the mileage of the projected point.

When the cross-section data is loaded, clicking the button allows you to switch to the cross-section view, as shown in figure 5.2-5.

Slope Layout

When the cross-section data and slope data are loaded, click the button, as shown in figure 5.2-6, to select the slope data to be loaded. Choose whether to load the slope on the left or right side of the cross-section, as shown in figure 5.2-7. In the cross-section view, you can see the loaded slope profile, with figure 5.2-8 representing a profile loaded on the left side.

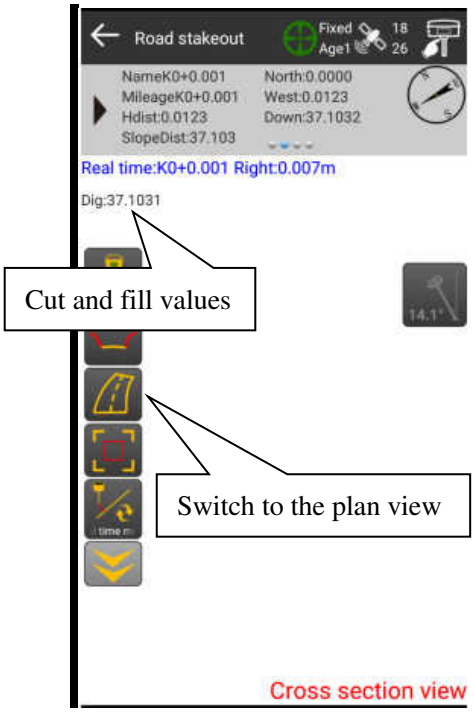


Figure 5.2-5

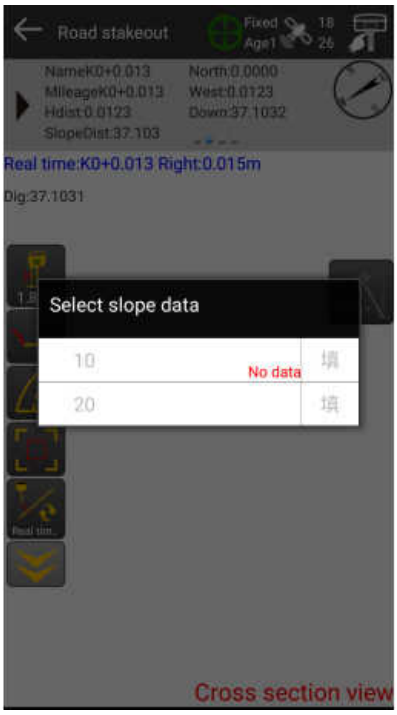


Figure 5.2-6

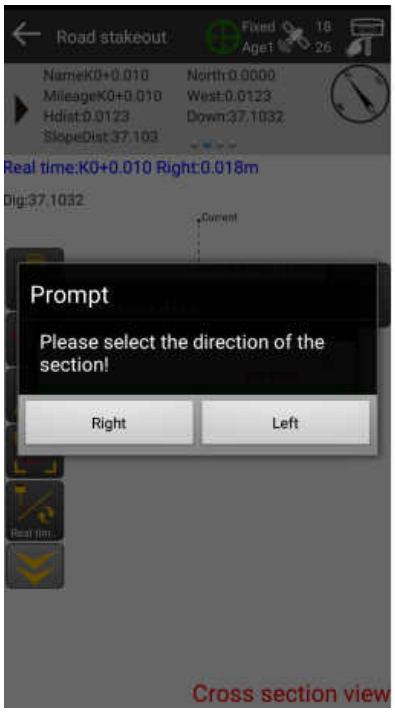


Figure 5.2-7

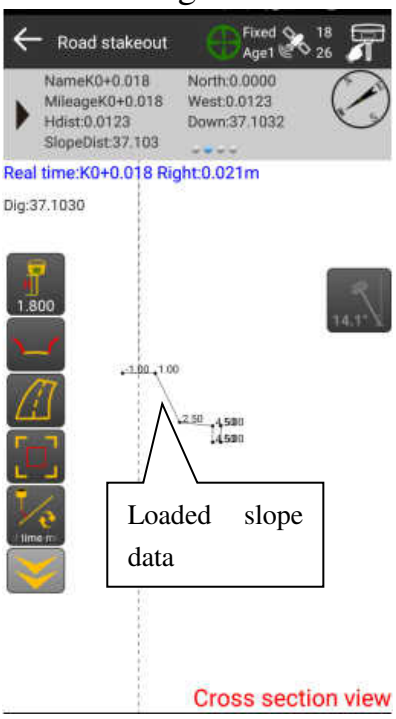
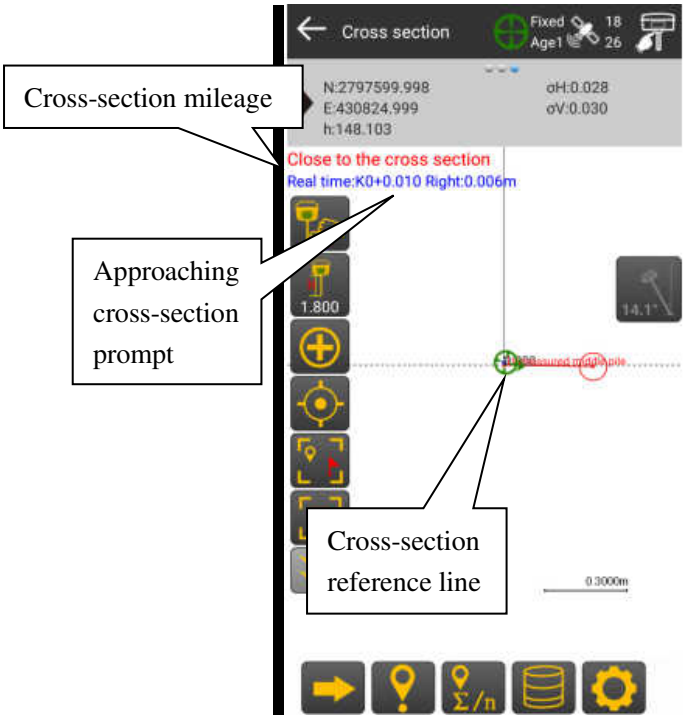


Figure 5.2-8

5.3 Cross-section data collection



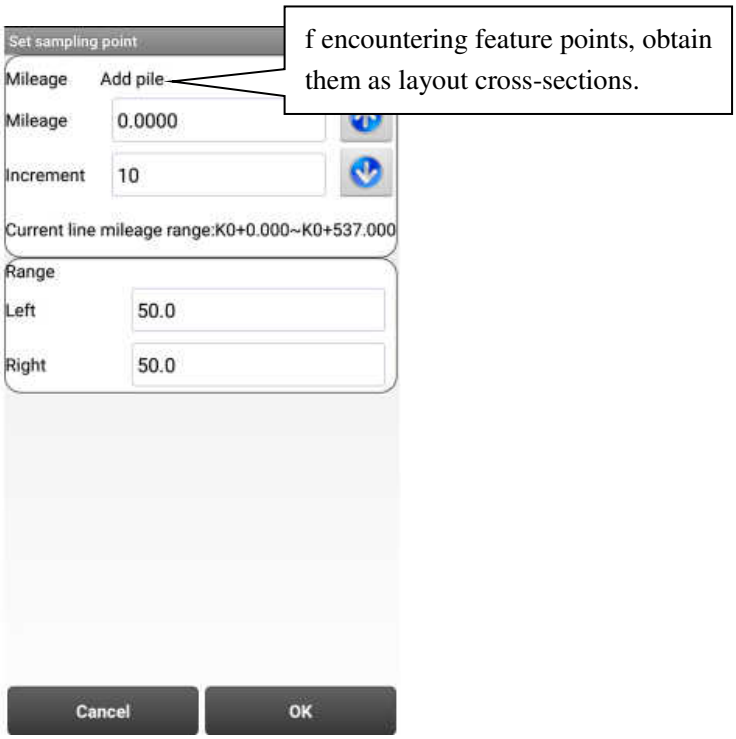


Figure 5-31 Figure 5-32

When collecting cross-sections, it is necessary to load the transverse section line and input the mileage, which can uniquely determine the position of a cross-section. Then, data points should be collected within a certain range of this cross-section. When processing the data, each point of the cross-sections must be distinguishable. Each cross-section must measure the center stake point (the midpoint at the specified mileage).

When conducting measurements, specify a mileage. The software will automatically calculate the position of the cross-section at that mileage and display a dashed line on the graph as a reference line (the lengths on the left and right sides of the line can be set when defining the cross-section position). When approaching this reference line, the software will calculate the distance between the current position and the reference line. If it is less than a certain distance value, cross-section points can be collected.

[Next Step] Enter the interface for defining cross-sections, as shown in Figure 5-32. You can input the mileage of the section to be measured, where the

mileage will be automatically accumulated based on the increment.

Mileage: Set the mileage for the current cross-section

Mileage Increment: The increase value of the mileage each time the form is entered or manually incremented or decremented by clicking.

Mileage Increment: Cross-section Range: The length on the left and right sides of the centerline that the cross-section deviates from (specifying the length of the cross-section reference line).

Note: When selecting the next section point, the software will automatically determine if a feature point (such as a tangent-curve point or curve-tangent point) is encountered. If a feature point is encountered, it will be captured as the layout section.

[Measurement Points] When the distance between the current position and the cross-section reference line is less than a certain distance value, cross-section points can be collected. In “Settings” - “Measurement” - “Section Distance Tolerance”, set the prompting distance. When the distance from the current point to the cross-section line is less than this value, the prompt “Approaching Cross-Section” will be displayed.

When you click on [Measurement Point], a cross-section point information window will pop up. You can specify whether the current point is a reference point. Refer to Figure 5-33. Click on [Confirm] to save the cross-section point. The cross-section point will be displayed as

on the diagram.

Note: Each cross-section must be measured with a reference point. If a certain cross-section has not been surveyed with a reference point, the text “未测中桩点” (Reference Point Not Measured) will be displayed at the reference point location. Each cross-section can only be measured with a reference point once. If it is necessary to re-measure the reference point, delete the reference point for that mileage from the cross-section point library or modify it to a non-reference point.

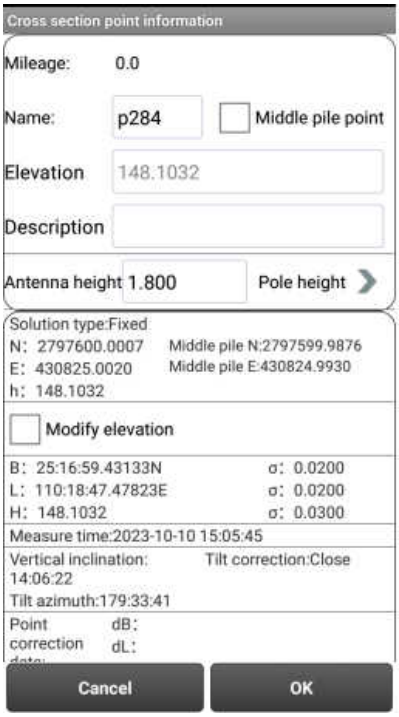


Figure 5-33

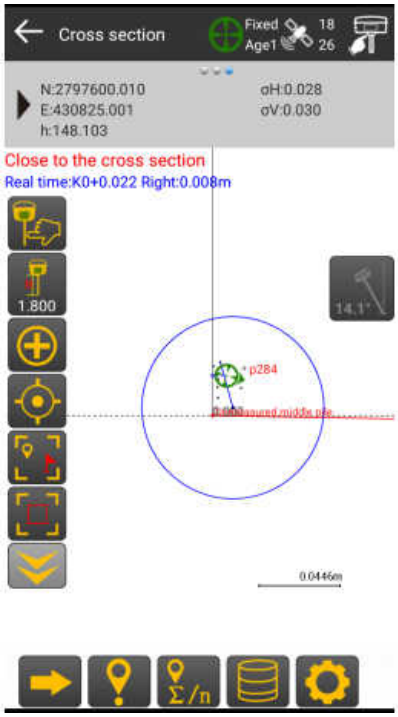


Figure 5-34

[Smoothing] Use smoothing acquisition to collect cross-section points.

[Zoom] Zoom in on the current point and cross-section reference line to display them on the screen.

[Line Library] For cross-section data collection, only the flat cross-section line file needs to be loaded.

[Switching] If there is a significant height difference in the cross-section direction, you can move back and forth along the route to measure, i.e., moving between different cross-sections for measurement. When approaching a previously surveyed cross-section (within a distance of less than 2m), the interface prompts whether to switch to the nearby cross-section. See Figure 5-34. By clicking the [Switch] button, the current cross-section mileage for data collection is switched to the closest cross-section, facilitating quick switching between cross-sections at different mileages.

Information Alert: The top information alert bar displays the cross-section mileage and the vertical distance from the current point to the cross-section reference line.

5.4 Cross-Section Point Library

As shown in Figure 5-35, the “Station” column in the point library list represents the cross-section mileage, and the “Offset” column represents the distance from the measurement point to the centerline point. If the cross-section point is a middle stake point, the label “Middle Stake” will be displayed in the bottom right corner of the point name. In the cross-section point library, points for each cross-section are grouped together. However, the cross-sections are not sorted in ascending order. When exporting the cross-section file, the points will be automatically sorted based on their cross-section mileage from smallest to largest.

Figure 5-35

Figure 5-36

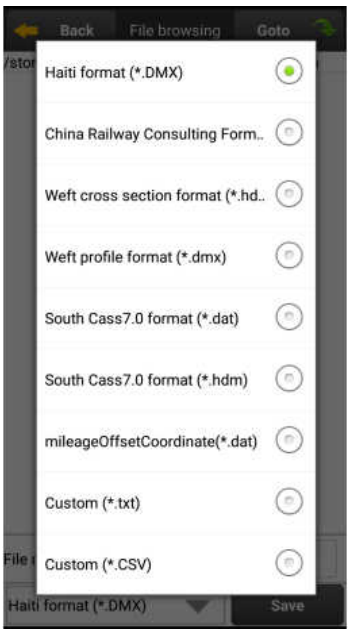


Figure 5-37

[New] Create a new cross-section point library file (*.crsp), as shown in Figure 5-36. The measured cross-section points are stored in the current cross-section file. The point library file can only be opened by the notebook and needs to be exported to other formats for use.

[Open] Open a cross-section point library file (*.crsp)

[Export] In the cross-section point library, it is possible to export it to other data formats, as shown in Figure 5-37, including Haitian format (.DMX), Weidi format, China Railway Consulting (.txt), etc.

Note: Please ensure that each cross-section has been measured with a middle stake point when exporting. If some cross-sections do not have a middle stake point

measured, a dialog box will prompt to ignore the cross-sections without a middle stake point during export.

Tip: Long press on a data item to enter multi-selection mode. In multi-selection mode, you can single-click or long press to make multiple selections. You can edit (only one point can be selected) or delete the selected points. Press the back key to cancel the selection.

Chapter VI. Power Measurement

Power measurement mainly includes power surveying, tower layout, and tower base cross-section measurement, as shown in Figure 6-1.

Figure 6-1

6.1 Introduction to Power Operation Procedures

1、Line Selection

Usually, the power department will first receive an aerial photo, satellite photo, or topographic map of the area where the power lines pass through. Some of these maps have known national coordinates, while others do not. The line selection personnel will determine the approximate location on the map based on the topographic map and then conduct a field survey to collect coordinates. They usually do not use GPS survey navigation. Instead, they drive directly to the approximate location on the map, search for landmark features, and find suitable positions for installing angle towers. If GPS or handheld devices are used to collect coordinates, high accuracy is not required. In flat terrain, a single-point positioning is sufficient to meet the requirements.

2、Measurement of flat cross-section

The line selection personnel selected a set of corner stakes based on the actual terrain and collected the coordinates. These coordinates were handed over to the survey personnel. The survey personnel connected these corner stakes in sequence to generate a power line. Then, within a certain range on both sides of the line, they collected terrain and features to form a strip-shaped cross-sectional data. Based on the requirements of the power department, this data is exported and used to generate cross-sectional diagrams using software such as DaoHeng. If there are any changes to the corner stakes during this phase, the features between the previous and subsequent points of this corner stake need to be remeasured.

3、Tower Base Cross-Section Measurement

This operation is performed during the measurement process by collecting a set of points at the tower position, forming cross-sectional data between the center point and the pit. The collected data of the tower base cross-section is used as a reference for later line pulling and pit calculation, as well as cost estimation.

4、Tower Line Pulling and Pit Calculation

For poles, it is necessary to balance the tension of the conductors, overcome wind resistance, and secure the top position of the pole with wires. For towers, it refers to the positions of the four bases. Common types include single-pole four-sided line pulling, double-pole “X” line pulling, and corner pole inline pulling. The types of towers include square towers, full-round square towers, and rectangular towers. The design team ensures that the positions of the line pulling, ground angles, and other attributes are determined in accordance with the power design regulations for later use by construction personnel.

5、Center-point positioning of poles and tower pits layout

The power layout function primarily aims to locate the positions of power poles or towers, as well as the positions of line pulling or tower foundations, for the installation of power facilities. Due to significant elevation errors associated with GPS, the use of total stations is more prevalent in this process. In line with the operational workflow in the power industry, the software provides power surveying capabilities to

assist surveyors in route selection, cross-sectional data collection, line pulling and pit calculations, and layout operations.

6.2 Power Survey

Power survey interface as shown in Figure 6-2.

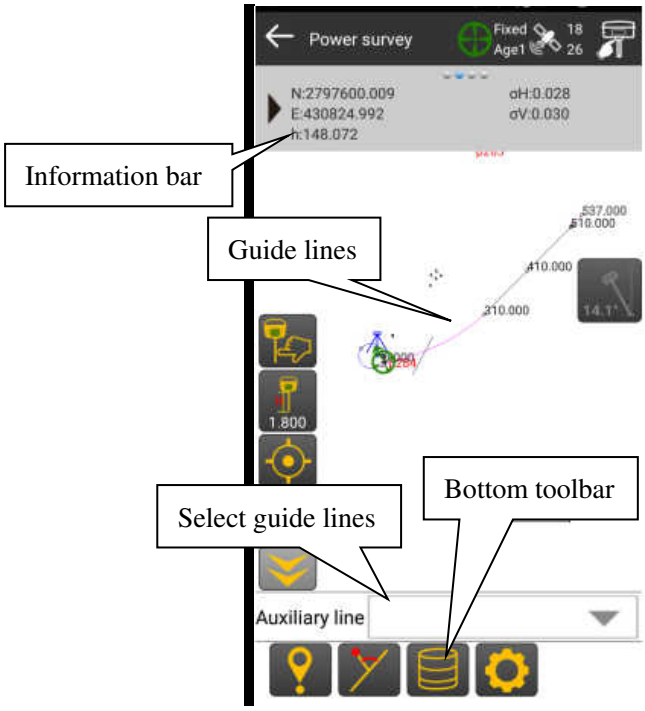


Figure 6-2 Figure 6-3

The bottom toolbar can be swiped horizontally, and the specific functions of the buttons dedicated to power measurement are as follows.

Collect power data points， Auxiliary tools， Auxiliary line library

Power survey operation process

1、Add guides

The purpose of alignment lines: The line selection team, based on the actual terrain, selects a set of turning points and collects their coordinates. These coordinates are then handed over to the surveying team. The surveying team sequentially connects these turning points to generate a power line, and then within a certain range on both sides of the line, collects terrain data to form a strip-shaped cross-section data.

Open the auxiliary line library , as shown in Figure 6-3. The bottom toolbar can be scrolled horizontally and includes options to add, insert, edit, delete, open, and

create.

[Add] alignment lines as shown in Figure 6-4. The starting and ending points of the alignment lines can be obtained through four methods: manual input, real-time collection, selection from the point library, and graphical selection. After completing the settings, click [OK] to add. The program automatically saves to the default file each time you add.

When there are already existing alignment lines in the line library, entering the add interface will set the starting point as the endpoint of the last alignment line by default.

Figure 6-4

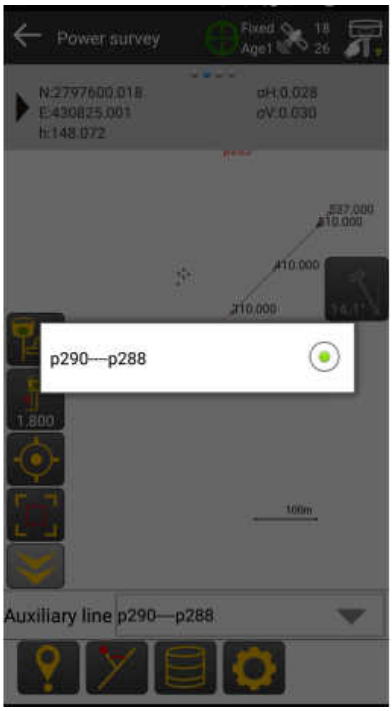


Figure 6-5

[Insert] Click to select the alignment line, and you can insert a line before the selected line.

[Edit] Click to select the alignment line and edit the selected alignment line.

[Delete] Click to select the alignment line and delete the selected alignment line.

[Open] Open a wire library file (*.eli), and the program will automatically load this file every time it starts.

[New] Create a new wire library file (*.eli).

After adding auxiliary lines, you can select the current auxiliary line segment in the auxiliary line list on the graphical interface, as shown in Figure 6-5. The current

auxiliary line segment is displayed in red, while the others are displayed in blue. The auxiliary lines have arrow indicators to indicate the direction of the wires.

Select an alignment line in the measurement interface to start the surveying operation.

The third page of the top information bar will display the real-time relationship between the current point and the alignment line, as shown in Figure 6-6.

Figure 6-6

Left deviation, right deviation: the current point is on the left or right side of the direction of the alignment line.

Distance to starting point: The current point's distance from the starting point of the alignment line.

Mileage: The current point's mileage at the projection point on the alignment line or its extension.

Distance to endpoint: The current point's distance from the endpoint of the alignment line.

Starting point elevation difference: The elevation difference between the current point and the starting point of the alignment line.

Left and right deflection angles: The angle (0~180°) formed by clockwise rotation (left) or counterclockwise rotation (right) from the direction of progress along the alignment line to the current point.

2、Power point collection

During the operation process, at the points where data collection is required for the features, record the current data using the [Survey Point] option. Then enter the power point collection interface, as shown in Figure 6-7. In the drop-down menu for the collection type, select the point type, as shown in Figure 6-8. Based on the point type, select the type of crossing object, such as road, river, pond, or building, and

specify the pole type, width, angular measurement, and height. Afterward, click “OK”. The software will save the feature attribute data to the measurement file. The rules for collecting points should follow the standards of Dao Heng software. During the office work, the power data will be converted to Dao Heng CAD format using the power processing software. The points collected through power survey will be displayed as + pt11 on the map.

During the measurement process, select the storage point type based on the current point’s feature type. The available storage point types include: J-pile (turning point), Z-pile (straight pile), ordinary point, wind deflection point, single-point measurement of power lines, communication lines, underground cables, etc., single-point measurement of roads, rivers, ponds, buildings, etc., two-point measurement of power lines, communication lines, two-point measurement of roads, rivers, ponds, buildings, etc., three-point measurement of roads, rivers, ditches, etc., left boundary point, right boundary point, and reference pile. There are a total of 12 types.

Figure 6-7

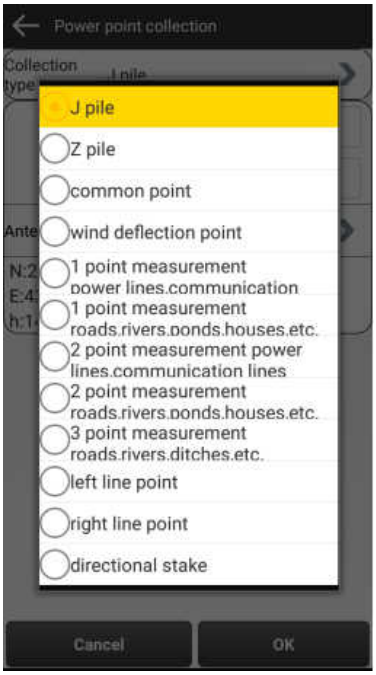


Figure 6-8

J Pile: Refers to a turning point pile.

Z Pile: Refers to a straight pile.

Ordinary Point: Refers to a general scattered point.

Wind Deflection Point: Refers to the points where power lines may come into contact with or be within a distance smaller than the specified value due to wind movement.

One-point Measurement of Power Lines, Communication Lines, Underground Pipelines, etc.: This includes power lines, communication lines, overhead optical cables, underground pipelines, trees, and other facilities.

One-point Measurement of Roads, Rivers, Ponds, Buildings, etc.: Measures the usage of railways, highways, rivers, ponds, and buildings.

Two-point Measurement of Power Lines, Communication Lines: Measures power lines, communication lines, etc., using this two-point measurement method.

Two-point Measurement of Roads, Rivers, Ponds, Buildings, etc.: Measures roads, rivers, ponds, buildings, etc., using this two-point measurement method.

Three-point Measurement of Roads, Rivers, Ditches, etc.: When measuring buildings, rivers, and ditches, this three-point measurement method is used.

Left Line Point: Measures points on the left line of the current route's direction of travel.

Right Line Point: Measures points on the right line of the current route's direction of travel.

Directional Stake: Used to indicate the position of the power line's direction.

(1) Collect J-stakes, Z-stakes, regular points, wind deflection points, left line points, right line points, and directional stakes. Simply input the point name and antenna height as shown in Figure 6-7.

Note: The pile names must not be duplicated. The names of ordinary points, wind deviation points, and left/right boundary points can be duplicated. While the names of ordinary points can be represented using pure numbers, wind deviation points and left/right boundary points cannot.

(2) One-point measurement.

[Testing Power Lines, Communication Cables, Underground Cables, etc.] During the surveying operation, when encountering power lines, communication cables, or

overhead optical cables on the route, attribute collection requires selecting the type of crossing, crossing object, pole type, and inputting information such as angle and height above ground. In the indoor processing stage, these details will be displayed on the plan and cross-sectional drawings in the RoadCAD software.

Angle: It refers to the angle between the crossing object and the vertical direction of the line. Negative values indicate a left direction, while positive values indicate a right direction. Both the angle and height above ground are mandatory and cannot be left blank. Please refer to Figure 6-10 for details.

Click on “Crossing Object Type” as shown in Figure 6-11 to select the corresponding crossing object. Different crossing objects require different parameters. For example, Figure 6-12 illustrates the parameters for “Forest”.

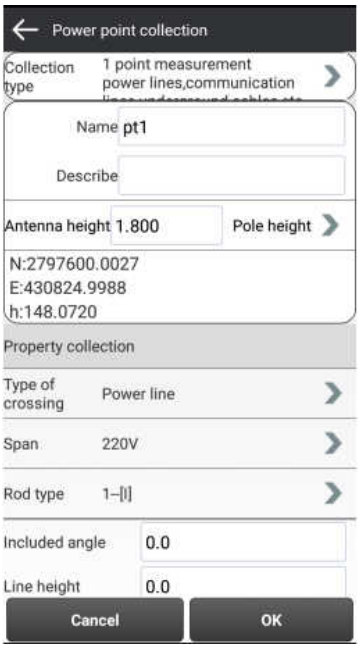


Figure 6-9

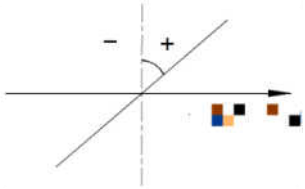


Figure 6-10

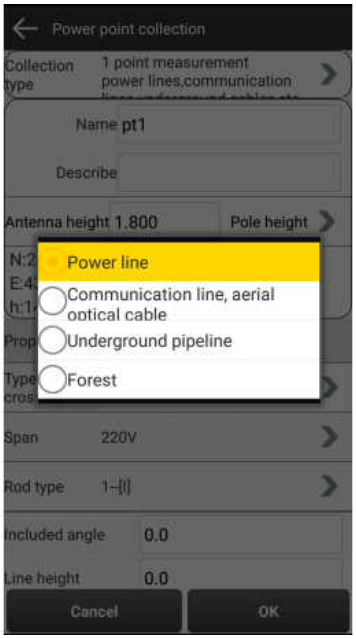


Figure 6-11

[Single-point Measurement of Roads, Rivers, Ponds, Buildings, etc.] When encountering roadways, railways, rivers, ponds, buildings, and other features along the survey route, you can store the measurements using the method of single-point measurement for roads, rivers, ponds, buildings, etc., as shown in Figure 6-13.

By clicking on “Crossing Object Type,” as shown in Figure 6-14, you can select the crossing object.

Note:

(1) When conducting single-point measurements for roads, rivers, ponds, and

buildings, the positive or negative sign before "± Road Width," "± River Width," and "± Ditch Width" indicates the orientation of the respective crossing object. Choose the positive sign when it is towards the larger side (in the direction of the survey route) and choose the negative sign when it is towards the smaller side. When measuring a ridge, you can directly select the orientation of the ridge.

(2) The positive or negative sign before "± Road Embankment Height" determines whether the road surface is drawn upwards or downwards. The road width should be rounded to the nearest integer, while the road embankment height can be represented with one decimal place. The ridge height can also be represented with one decimal place.

(3) The "Water Level Height" for river measurements and the "Ditch Bottom Depth" for trench measurements only support drawing downwards, and can be represented with one decimal place.

(4) During the measurement of buildings, the room corner angle is the angle between the building's length and the direction of the survey route, ranging from -90° to 90°. When the room width is a negative number, it indicates that the direction of the room width is on the left side of the building's length. Conversely, when the room width is a positive number, it indicates that the direction of the room width is on the right side of the building's length. The room height can be represented with one decimal place.

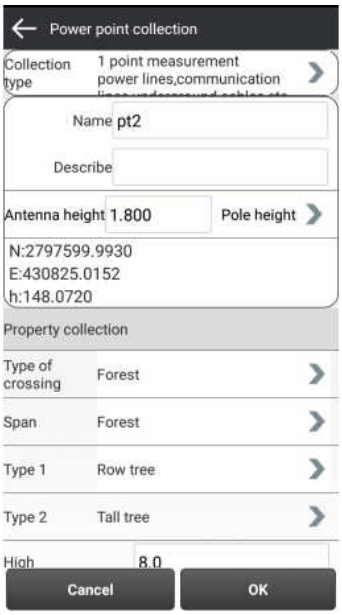


Figure 6-12

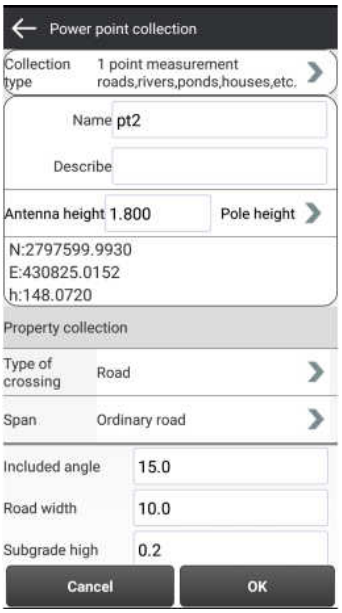


Figure 6-13

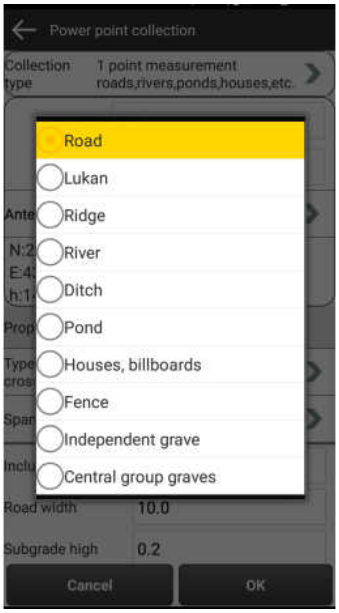


Figure 6-14

3、two-point measurement

[Two-Point Measurement of Power Lines and Communication Lines] After selecting the two-point measurement option for power lines or communication lines, under the attribute collection, choose the crossing object type, crossing object, pole type, and measurement height.When collecting the first point, the software will prompt for the first point, as shown in Figure 6-15. Click [OK] to return to the power survey interface. Then, move to the next point and press the [Measurement Point] button to enter the second point collection interface, as shown in Figure 6-16. At this point, simply enter the description, antenna height, and measurement height.

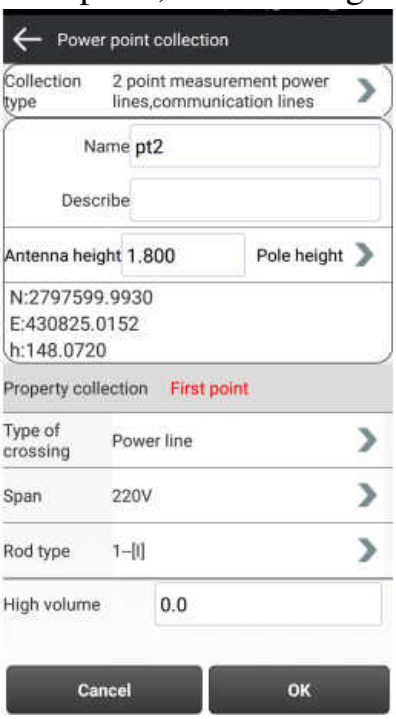


Figure 6-15

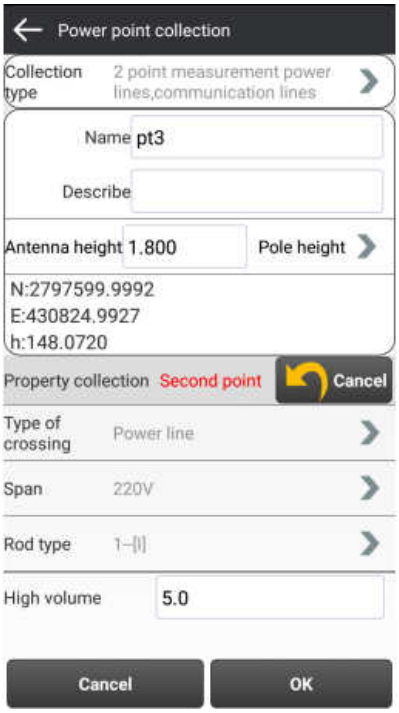


Figure 6-16

[Two-Point Measurement for Roads, Rivers, Ponds, Buildings, etc.] This feature allows for a relatively accurate measurement of the width of various land features.To begin, press “OK” at one end of the land feature to save the settings. Then select the option for two-point measurement of roads, rivers, ponds, buildings, etc. At the attribute collection stage, the software will prompt for the first point. Choose the crossing object type and input the crossing object angle. Once saved, proceed to the other end of the land feature to collect the second point. The software will automatically prompt for the second point. At this stage, you only need to input the roadbed height, water level height, and so on.

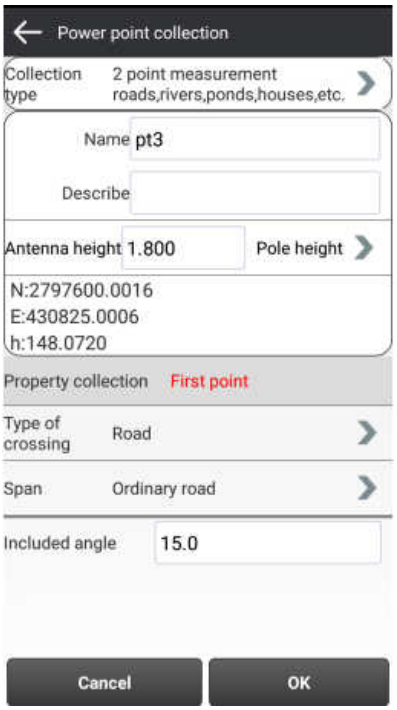


Figure 6-17

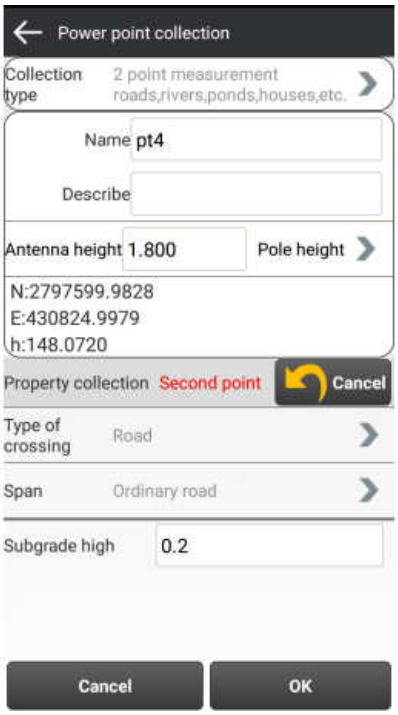


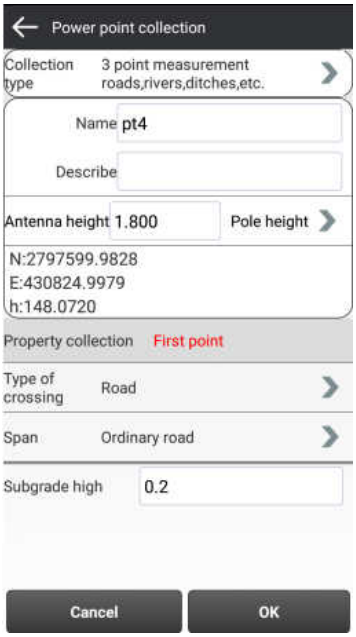
Figure 6-18

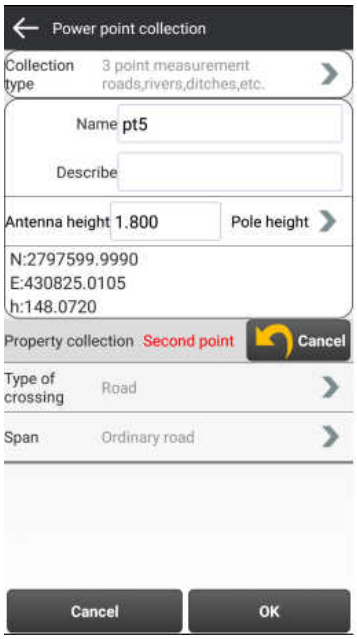
If you wish to undo the first point, click on the [Undo] button labeled as . The software will prompt with the message “Are you sure you want to abandon the current collection?” Choose “OK” to return to the first point collection interface and start the collection process again. (The measurement order of the two endpoints of the land feature can be arbitrary. The software will automatically determine the front and back breakpoints of the land feature based on the direction of the line.)

When conducting multi-point measurements, the collected data will only be stored in the power point database upon completion of all data acquisition. During the data acquisition process (e.g., the first point in a two-point measurement or the first two points in a three-point measurement), temporary power points will be displayed on the graphical interface. The temporary points will be marked in red.

4、three-point measurement.

When conducting a three-point measurement for roads, rivers, ditches, etc., the first and second points determine the direction, while the first and third points determine the width. Input parameters such as roadbed height, water level, etc. are required for the first point, while the second and third points do not need to be entered.





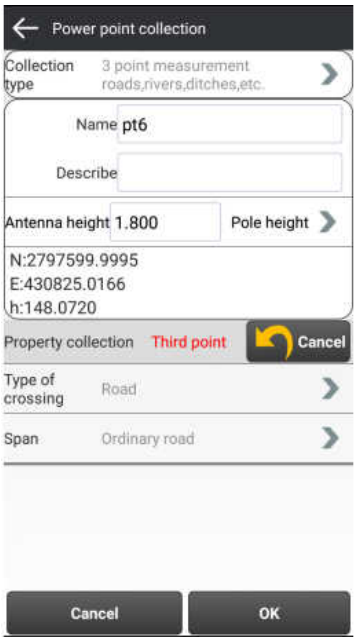


Figure 6-19 Figure 6-20 Figure 6-21

Each time you enter the data collection form, the point number will automatically increment. The point name prefix is based on the historical record of the last used prefix.

assistive tool

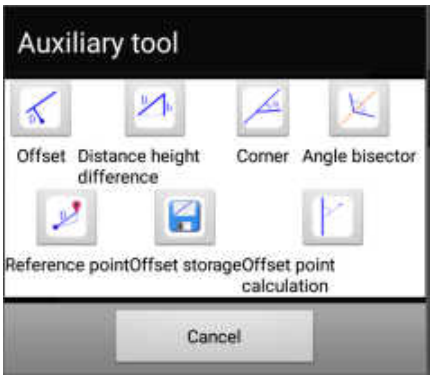


Figure 6-22

Click on the toolbar's assist button to open the Assistive Tools dialog box, as shown in Figure 6-22. The calculation results of the assistive tool will be displayed on the 4th page of the top information bar.

Offset Calculation: Calculate the offset between a point and a straight line. First, click on the screen to select the starting point and endpoint of the reference line (only electric measurement points and auxiliary line endpoints can be selected). Then,

select the point to be calculated. The calculation results include: direction (left offset or right offset), distance from the starting point along the line, distance from the endpoint along the line, and offset distance from the point to the perpendicular. The selected reference line and the line from the point to the perpendicular are displayed on the screen, as shown in Figure 6-23.

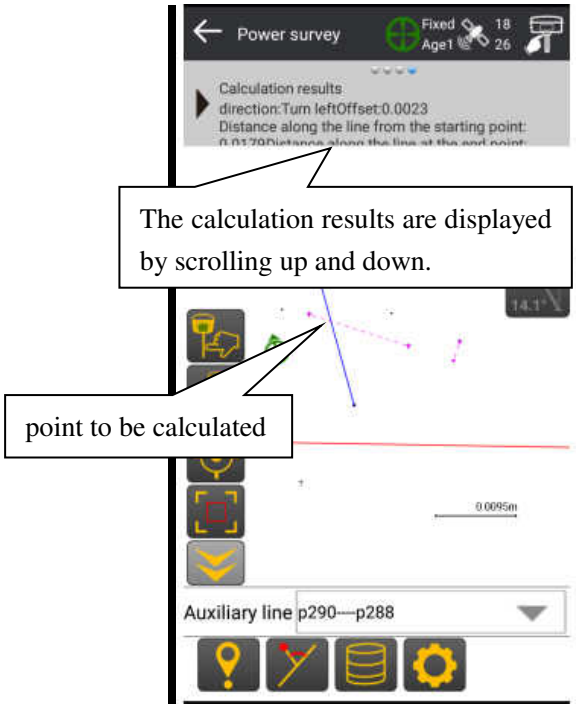


Figure 6-23

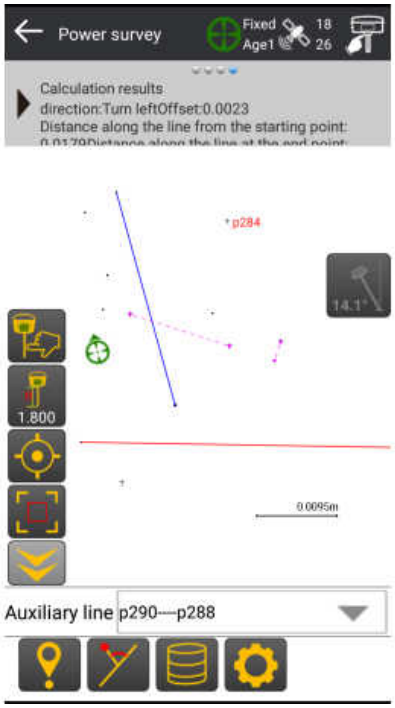


Figure 6-24

Elevation Difference Calculation: Click to calculate the elevation difference between two points. On the screen, select the two points to be calculated in sequence, and you can calculate the horizontal distance, slope distance, elevation difference, and azimuth angle between the two points.

Turning Angle Calculation: Calculate the turning angle. First, select two points, and then choose the turning point. This will allow you to calculate the direction and magnitude of the turning angle at the turning point. It can be used to calculate turning angles during the route selection process or crossing angles during the horizontal cross-section measurement process, as shown in Figure 6-24.

Adding Angle Bisector: Add an angle bisector by selecting three points in sequence to find the angle bisector of the included angle between the three points. The angle bisectors can be classified as interior and exterior bisectors. The rule for defining interior and exterior bisectors is based on the order of the selected points. The interior bisector is the angle formed by clockwise rotation from the first point towards the third point, while the exterior bisector is formed in the opposite direction. You can choose to add either an interior or an exterior angle bisector and designate the endpoint with a point name, as shown in Figure 6-25. The bisector will be added to the auxiliary line library, as shown in Figure 6-26.

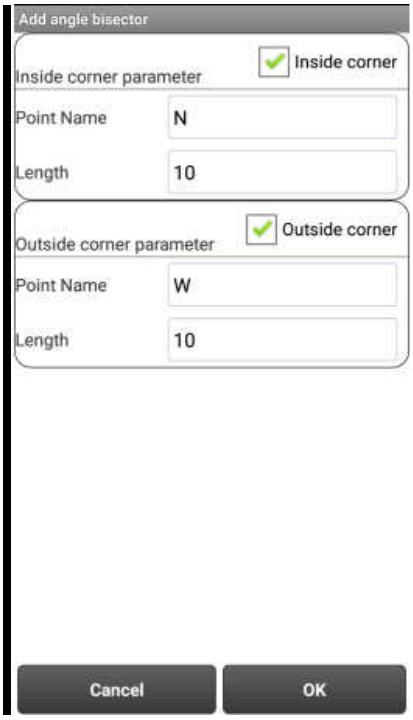


Figure 6-25

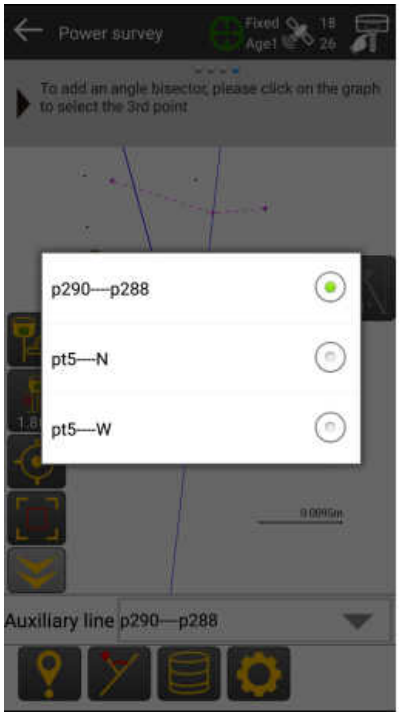
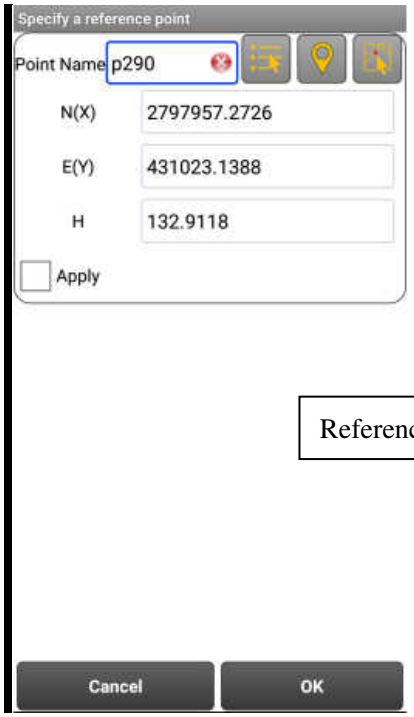


Figure 6-26

Reference Point: Specify a point as the reference point. When the reference point is enabled, the top information bar displays real-time distance and elevation difference between the current point and the reference point. The reference point is

represented by a red triangle symbol on the map, as shown in Figure 6-27 and Figure 6-28.



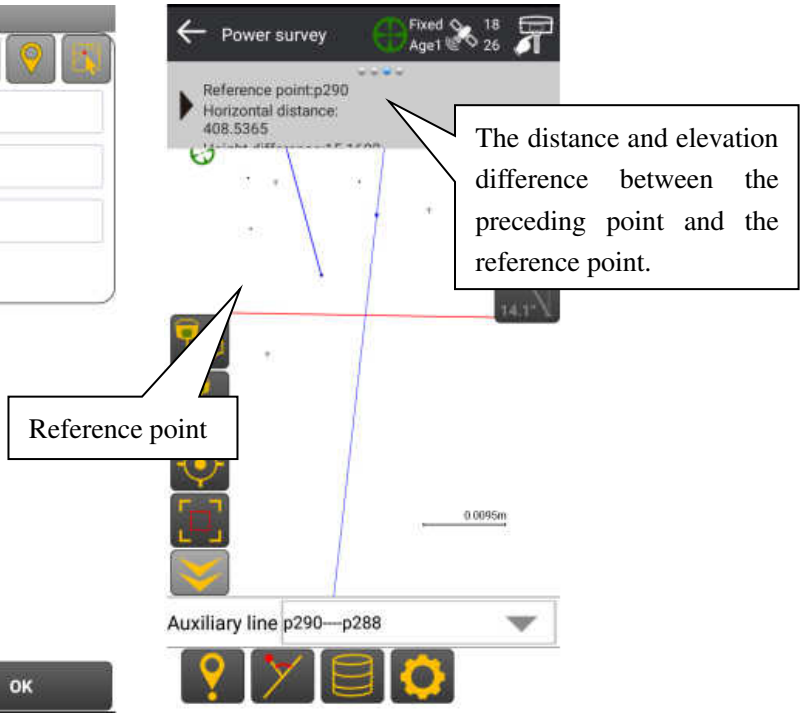


Figure 6-27 Figure 6-28

Offset Storage: On the screen, select two points to determine a reference line, then choose whether to use the starting point or the endpoint as the offset reference point and in which direction to offset. For example, selecting 'Before endpoint' means offsetting in the direction from the starting point towards the endpoint, with the endpoint extending further in the offset direction. The same principle applies to the other three directions. Finally, input the offset distance and elevation difference to calculate the offset point, as shown in Figure 6-29. Once the coordinate calculation is complete, you can switch to the power point acquisition interface and save it to the power point database, facilitating the collection of targets that are unreachable.

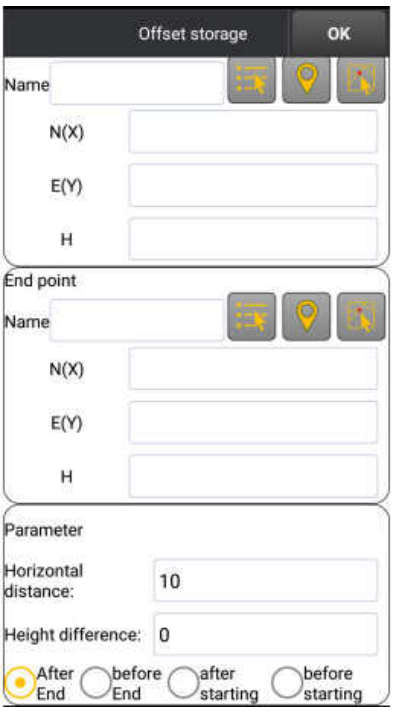


Figure 6-29

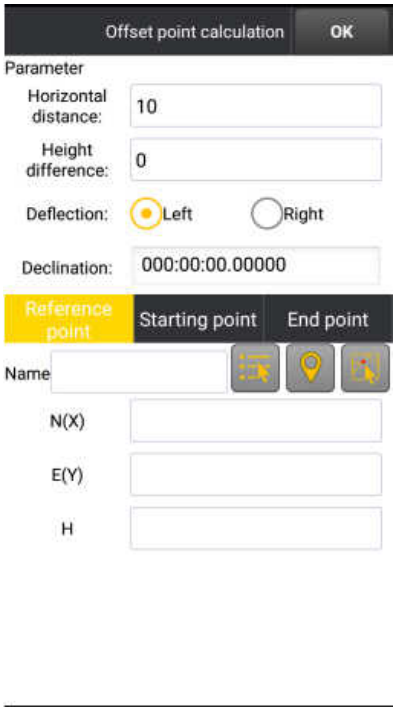


Figure 6-30

Offset Calculation: In the offset calculation interface, input the coordinates of the starting point, endpoint, and reference point, as well as the distance and elevation difference values. Set the offset direction and angle to calculate the coordinates of the offset point, as shown in Figure 6-27. The starting point and endpoint determine an azimuth. By adding the offset direction and angle to the azimuth, the azimuth from the reference point to the offset point is determined. The coordinates of the offset point are calculated based on the distance and elevation difference, and the reference point does not have to be on the line connecting the starting point and endpoint. Once the coordinate calculation is complete, you can switch to the power point acquisition interface and save it to the power point database, facilitating the collection of unreachable targets.

6.3 Transmission tower layout

The power survey interface is shown in Figure 6-28.

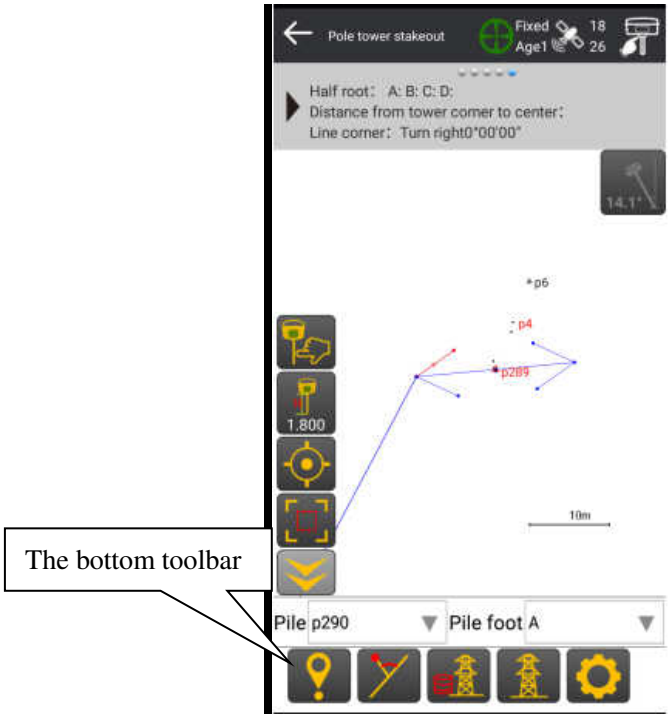


Figure 6-28 Figure 6-29

The bottom toolbar can be slid left or right. The specific functions of the buttons dedicated to transmission tower layout are as follows

The auxiliary tools， The tower library， The standalone tower

Before starting tower layout, it is necessary to add tower components from the tower library. Tower foundation layout is conducted based on the power survey lines, with one tower designed for each corner point.

Note: The orientation of the tower is determined by the direction of the power line, so at least two towers need to be added in order to proceed with the layout.

tower library

Click the tower library button to open the tower library interface, as shown in Figure 6-29. The bottom toolbar includes options for adding, inserting, editing,

deleting, opening, and creating new items.

[Add] Add power tower: Select the stake type: pole or tower, enter point name, coordinates, mileage value, and set parameters.

[Insert] Insert a stake before the selected position.

[Edit] Click to select a position for editing.

[Delete] Remove the selected position.

[Open] Open a tower file (*.ptr).

[New] Create a new tower file (*.ptr).

1、Add pole

Refer to Figure 6-30, select the 'Pole' option for configuration.

Figure 6-30

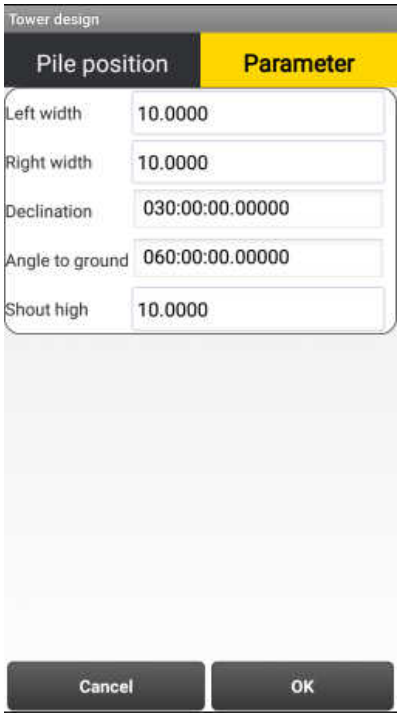


Figure 6-31

Pole Design: Enter point name, coordinates, and stationing (optional). Input pole parameters: left width, right width, skew angle to ground, and sag height, as shown in Figure 6-31. The four pit locations are named ABCD, with their definition being oriented in the direction of the line's progression, where the bottom-right point is referred to as A, and the other three points are named BCD in a counterclockwise direction, as shown in Figure 6-32.

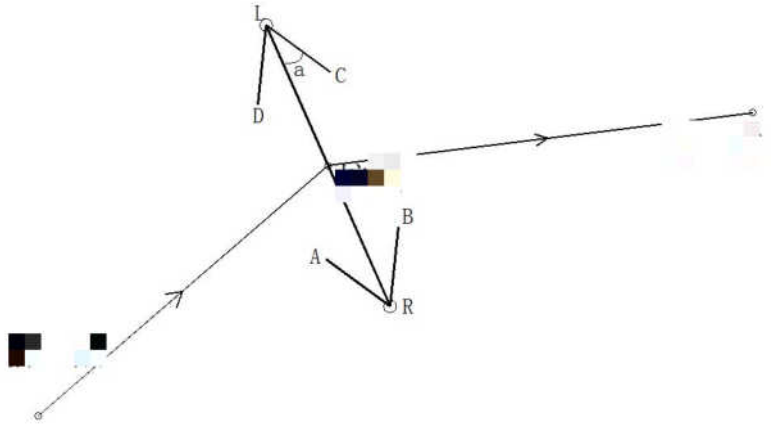


Figure 6-32

The direction of the pole is determined by the bisector of the line's corner. L and R represent the left and right poles, respectively. The skew angle parameter is the angle between the direction of the tension line and the line connecting the two poles, with all four angles being the same. The left width and right width are the distances from the pole positions to L and R, respectively. Sag height is the angle between the tension line and the vertical line (in degrees).

Tower Design: Enter point name, coordinates, and stationing (optional). In the type dropdown list, select the type of tower. Input tower base parameters, as shown in Figure 6-33 (here, input values are half of the actual length and width). The four pit locations are named ABCD, with their definition being oriented in the direction of the line's progression, where the bottom-left point is referred to as A, and the other three points are named BCD in a clockwise direction, as shown in Figure 6-34.

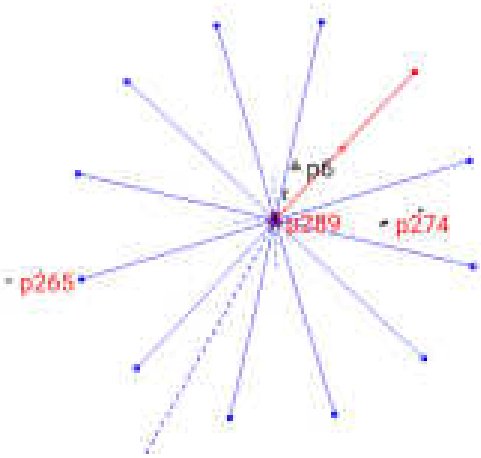
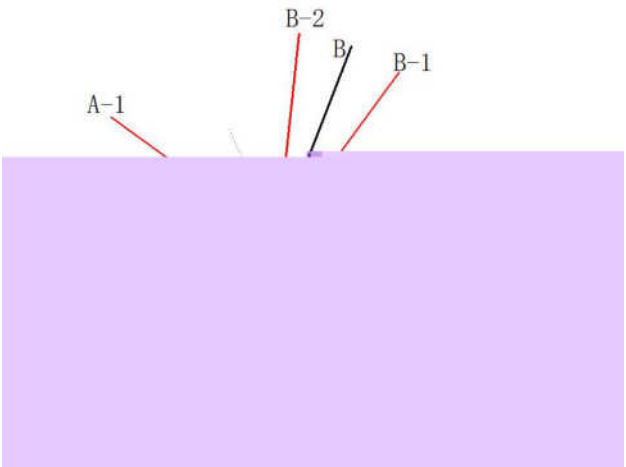


Figure 6-33 Figure 6-34

There are three types of towers: square tower, rectangular tower, and square tower (omni-directional). For square towers, the input value for half the opening ‘a’ is required. For rectangular towers, input values for half the openings ‘a’ and ‘b’ are required. The values for half the openings must be greater than 0. If you need to add pedestal joints, the angle must be less than 45°. In the ‘Add Pedestal Joints’ editing box, input the angle between the added pedestal joint line and the original pedestal joint line. Adding the pedestal joints will increase the number of pedestal joints from the original 4 joints (ABCD) to an additional 8 joints, as shown in Figure 6-35. The newly added pedestal joints are denoted by adding ‘-1’ and ‘-2’ to the original naming convention.



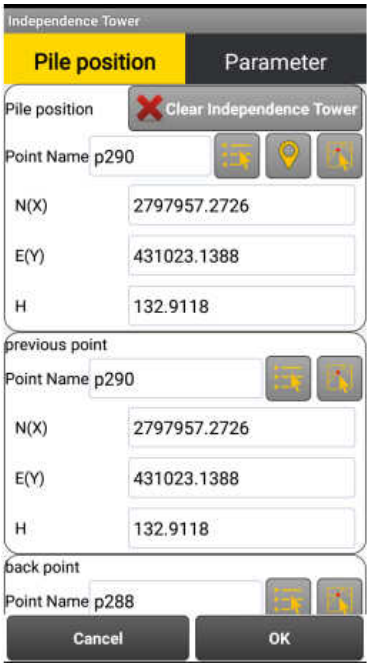


Figure 6-35 Figure 6-36

independent tower

Click on the [Independent Tower] button to open the Independent Tower interface, as shown in Figure 6-36. The [Independent Tower] feature allows you to add a standalone tower. In addition to inputting the coordinates of the tower location, you also need to input the previous and next points to determine the alignment of the line.

The other parameters are the same as those in tower design. After adding an independent tower, you can select it for pit layout.

Note: The data of the Independent Tower is temporarily stored in the memory and is not saved to the project. If you reopen the project, the data will be cleared.

layout process

In the layout interface, select the designed tower. Firstly, choose the specific pile location from the first dropdown list. Then, choose the corresponding pit location from the second dropdown list. A line will be formed connecting the pit location to the pile location. The software will display the selected pit line in red color, while the unselected ones will be displayed in blue color. The software will also show a line connecting the current position to the starting point of the layout line, as shown in Figure 6-37.

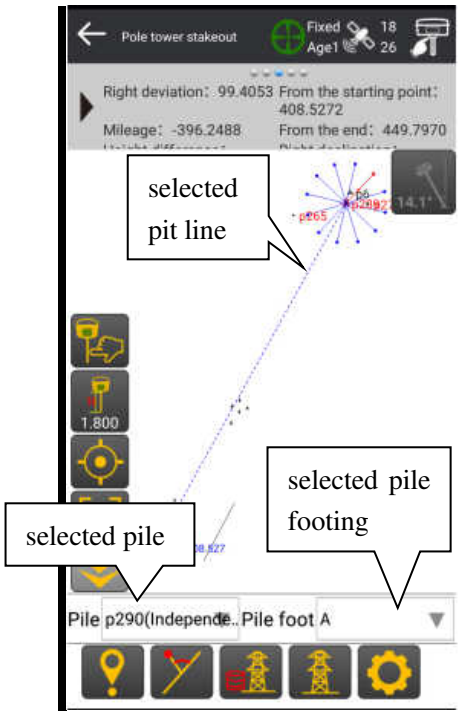


Figure 6-37

Figure 6-38

Top information bar displays real-time position data from the current point to the layout line, enabling precise positioning near the layout line. For pole layout, the information bar shows the real-time creation of ground angles at the current position, assisting users in controlling the three-dimensional spatial form of the tensioned line.

When the user selects a specific pile location by pulling down, the diagram

automatically scales to display the current point and pile location within the screen.

assistive technology

The assistive tools here are essentially the same as those used in power surveying, with the addition of the [added straight line pile] feature.

Straight Pile Addition: Click on a point on the line on the screen to select a pile point. A pop-up interface for adding a straight pile, as shown in Figure 6-39, will appear. Enter the distance between the added pile point and the selected point, and click 'Confirm' to complete the pile addition. The added pile point can be added to the tower pole library.

Attention: There must be at least two existing poles on the line in order to add a straight pile. The selected pile position on the diagram cannot be the last point on the route.

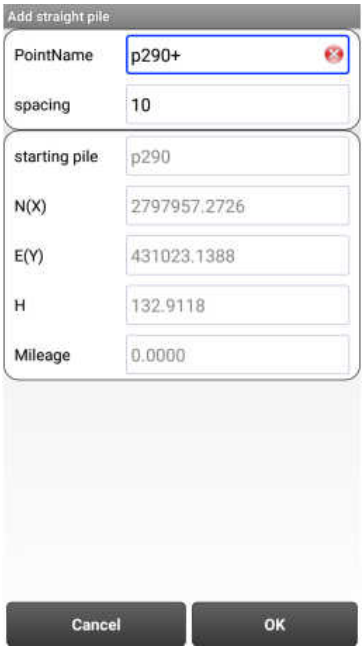


Figure 6-39

6.4 foundation cross-section of the tower

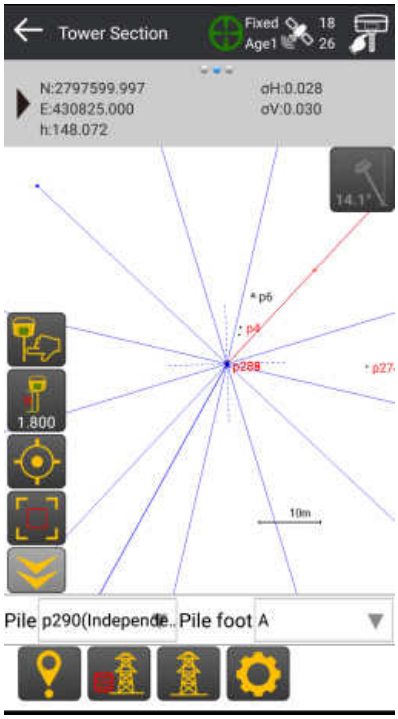


Figure 6-40 Figure 6-41

Tower foundation section measurement involves collecting a set of points at the tower location to form cross-sectional data between the center point and the excavation site. The collected results of the tower foundation section are used as a reference for later calculations of cable pulling and excavation cost estimation.

When conducting tower foundation section measurements, start by defining the tower foundation section (adding a tower). Please refer to the help file for the tower layout for the defining methods. You can add pile points as needed (angle < 45°) and define up to 12 tower foundation section lines. After selecting the tower foundation pile locations and tower feet, following the prompts in the top information bar, move the receiver within a certain distance of the section line to perform the section measurement. Click the [Measurement Point] button to display the section point data, as shown in Figure 6-41. Click 'Confirm' to save the data in the section

point library (*.tfsp). The section point library file can be converted into a Dohene format for section profiling using power post-processing software. The tower foundation section points are displayed on the diagram as t21.

6.5 Power Point Database

The Power Point Database stores the data collected from power surveys. The points in the Power Point Database can be added, exported, created, and opened. Long-pressing allows for editing and deleting operations. The power point library file (.elp) in the handbook needs to be exported as a power point file (.ele) in order to use power post-processing software to convert it into the Daoheng data format.

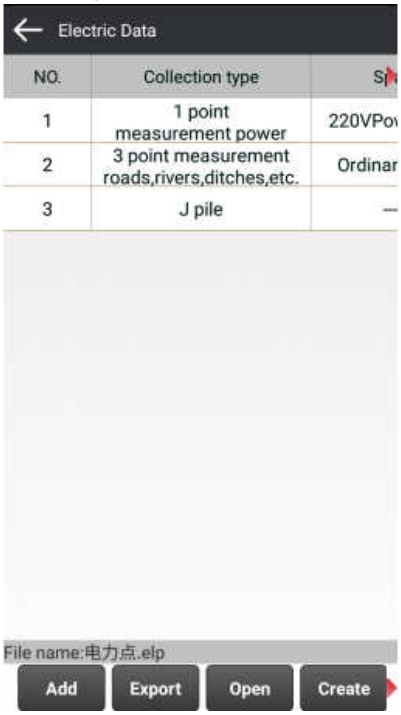


Figure 6-42

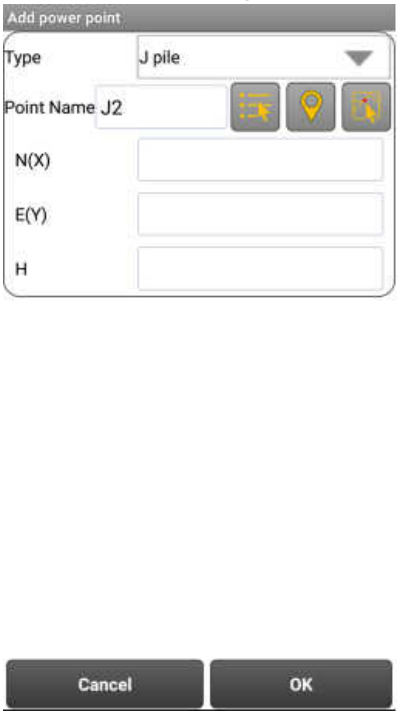


Figure 6-43

[Add]: To add a power point measurement point, you can obtain the point through the coordinate library, measurement, or graph selection methods. The types of points that can be added are limited to: J pile, Z pile, ordinary point, and direction pile, as shown in Figure 6-43.

[Export]: Export the power point library file (.elp) of the current project as a power point file (.ele) for opening with post-processing software, as shown in Figure

6-44.

[Open]: Open the power point library file (*.elp), and the measured points will be retained in the currently opened file.

[New]: Create a new point library with the suffix (*.elp).

[Edit]: Long-press to select the power point that needs to be edited. Press the back key to cancel the selection. Single-click on the selected point to enter the editing interface for power points, where you can edit the point name, description, and attributes.

[Delete]: Delete the selected power point.

Figure 6-44

Figure 6-45

6.6 cross-section point library.

When conducting tower foundation cross-section measurements, the data is saved in a cross-section point library (.tfsp) file. The cross-section point library file can be converted into the DoHyung format (.org) using power post-processing software for cross-section plotting.

Figure 6-46 Figure 6-47

[New]: Create a new cross-section point library file (*.tfsp).

[Open]: Open the cross-section point library file (*.tfsp).

[Export]: You can export the number of cross-sections to other data formats, as shown in Figure 6-47:

Excel file (*.csv): Export all data items of the cross-sectional points.

CAD file (*.dxf): Export cross-sectional points to a graphic file.

Southern Cass (.dat) file.

Custom (.csv), Custom (.txt): Users can select the data items to be exported, as shown in the illustration.

[Edit] Long press on a data item to perform editing. Press the back key to cancel the selection, as shown in Figure 6-48. Only the point name, description, and antenna height can be modified.

[Delete] Delete the selected data.

Tower base section point library
Name
N
E
t1
2797599.9984
430825.0162
File name:1.tfsp
Editor
Delete

Figure 6-48

Chapter VII. Tools

The tool interface is shown in Figure 7-1.

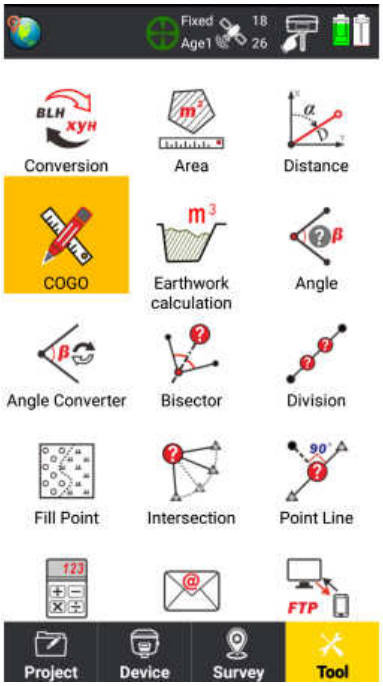


Figure 7-1

7.1 Coordinate conversion

[Forward Calculation] Convert the plane coordinates from the source ellipsoid (WGS84) to the local ellipsoid.[Inverse Calculation] Convert the local plane coordinates back to WGS84 coordinates.The calculations are performed using the coordinate system parameters (projection parameters, seven parameters, etc.) set in the current project.Coordinate points can be collected in real-time from the receiver, selected from a coordinate database, or picked from the map, as shown in Figure 7.1-1.The calculation results can be saved to the measurement point database, as shown in Figure 7.1-2.

Note: Clicking on the switches between “Geodetic,” “Spatial,” and “Planar” will not convert the coordinates currently entered. It only switches to different input formats.

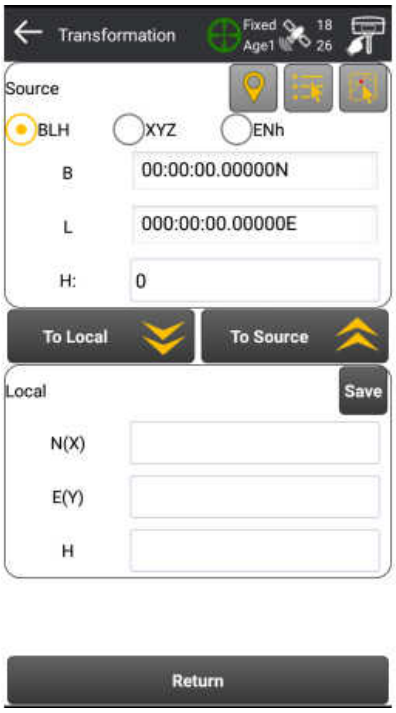


Figure 7.1-1

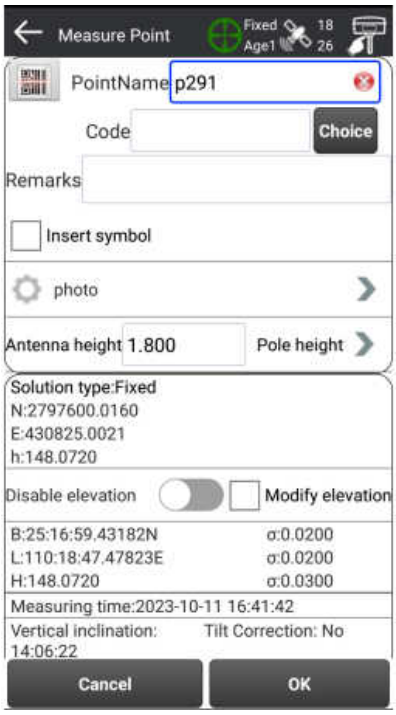


Figure 7.1-2

7.2 Area and Perimeter Calculation

There are two options to calculate area and perimeter: measuring on the map and calculating in a list. Measuring on the map is commonly used.

1、Measuring Area on the Map

As shown in Figure 7.2-1, the boundary lines can be determined through two methods: drawing lines and selecting lines.

[Drawing Lines] Similar to drawing polylines, click or slide on the map to draw multiple segments of lines. The area is displayed in real-time in the center of the shape. When the lines are completed, there is no need to close them to the first point. Simply click the [Calculate] button, and the lines will automatically close, and the area and perimeter will be calculated. Click the [Save] button in the dialog box to bring up the save dialog, as shown in Figure 7.2-2, where you can input the corresponding plot name and description. While drawing the polylines, you can undo or redo the drawing operations. Clicking [Cancel] will cancel the ongoing drawing of the polylines.

[Selecting Lines] By selecting existing closed polylines on the map, you can calculate the area. Only one segment of line can be selected at a time. If the selected segment is not closed, it can be automatically closed for area calculation.

[Picking] By using the selection box, you can pick the saved area lines and perform operations such as deletion and text editing.

2、List calculation

As shown in Figure 7.2-3, list calculation is performed by inputting or selecting points to determine a boundary line.

The coordinates of the boundary line points can be manually inputted, collected in real-time from the receiver, or selected from the coordinate library or the map.

[Add] Add points to the calculation list.

[Insert] Click on a point in the list and insert a new point before the selected point.

[Edit] Edit the selected point.

[Delete] Remove the selected point.

[Compute] When the number of points in the list is no less than three, calculate the area and perimeter of the geometric shape formed by the points in the current list in order.

3、area line data

The saved area line data can be viewed in the data list, as shown in Figure 7.2-4.

[Edit] Selecting a data item allows you to edit the name and description of the area line.

[Delete] You can delete the selected area line in the list. Once deleted, it cannot be undone or recovered.

[Locate] Selecting a data item enables you to locate the position of the area line on the graph.

[New] Area line data is saved in an area file (*.area), which allows you to create or open an area file. Within a project, you can create multiple area files, and the saved data is stored in the currently open file.

[Open] Open an area file to load the area line graphics.

[Export] The area file (.area) is a temporarily stored binary file that cannot be directly opened and used on the computer. It needs to be exported to other formats. Export options include CAD (.dxf), shapefile (.shp), and Excel (.csv) formats.For exporting a DXF file, the closed lines and text labels are placed in the “JZD”

(boundary point) layer, and they can be selected together when the file is opened as a group.For exporting a shapefile, it includes four attributes: area, name, description, and perimeter.

[Note] The exported graphic files here consist only of individual area line data and do not include other graphic data. In the “Import/Export” interface, when exporting a DXF file, it is possible to export both the area data and the graphic data together.

[Settings] As shown in Figure 7.2-5, you can configure the following settings for the area lines: fill color, display of name and description, text label font size, decimal places, and area unit.

[Note] The settings for font size, unit, and other options apply to the sketch map and the exported graphic files. When the display of name or description is turned off, they will not be included in the exported graphic files.

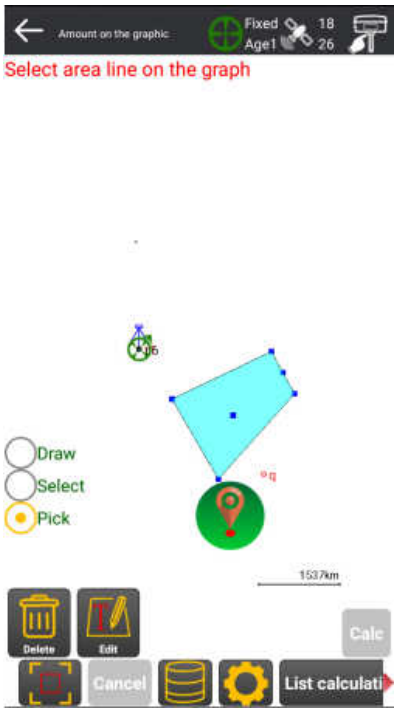


Figure 7.2-1

Figure 7.2-2

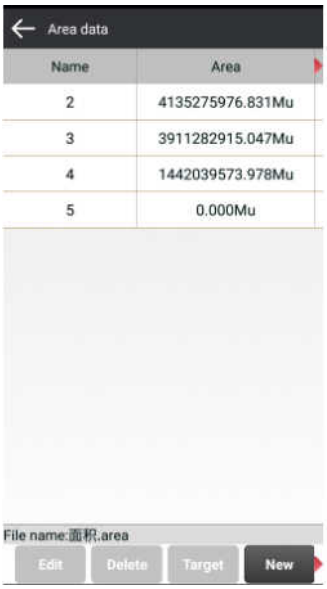


Figure 7.2-3

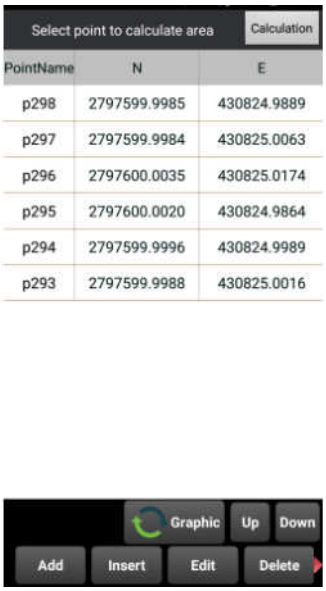


Figure 7.2-4

Figure 7.2-5

7.3 Distance and Bearing Calculation

[Distance and Bearing Calculation] To calculate the distance and bearing between two points, you can manually input the coordinates of the starting and ending points, or select them using measurement tools, coordinate libraries, or by selecting on the map as shown in Figure 7.3-1. Once the settings are completed, click “OK” to calculate the “planar distance,” “spatial distance,” and “bearing” between the two points.

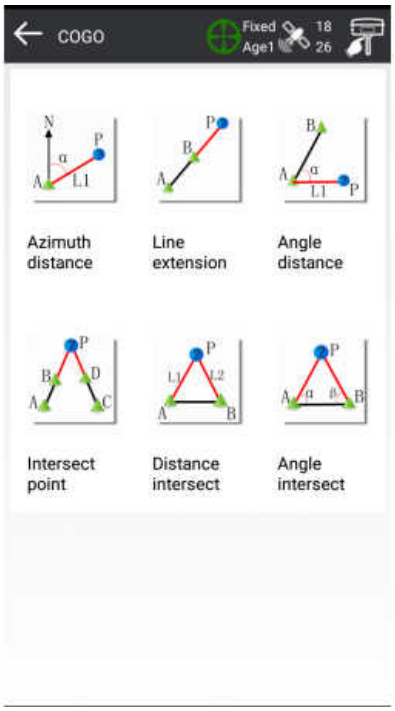


Figure 7.3-1 Figure 7.4-1

7.4 Coordinate Calculation

[Coordinate Calculation] Coordinate calculation includes six methods: One Point and One Side, Two Points and One Side, Two Points and One Angle, Intersection of Two Lines, Two Points and Two Sides, and Two Points and Two Angles, as shown in Figure 7.4-1.

Input known point coordinates and parameters. Coordinates can be manually entered, measured, selected from a coordinate library, or picked on the graph. Click the [Calculate] button to compute the coordinates of the target point, and click [Save] to store the calculation results in the measurement point database.

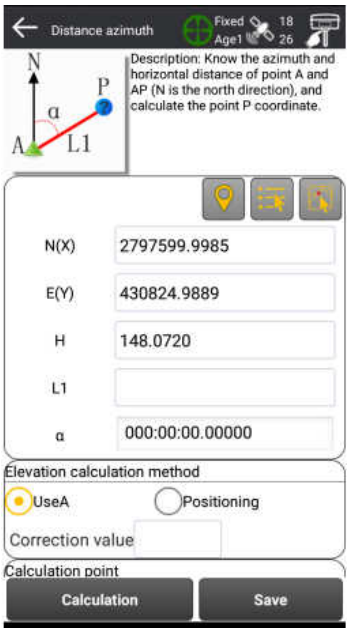


Figure 7.4-2

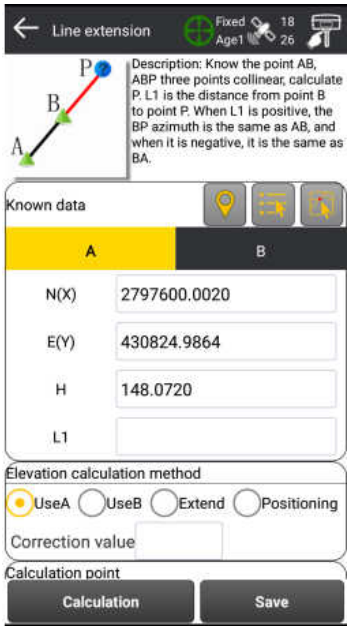


Figure 7.4-3

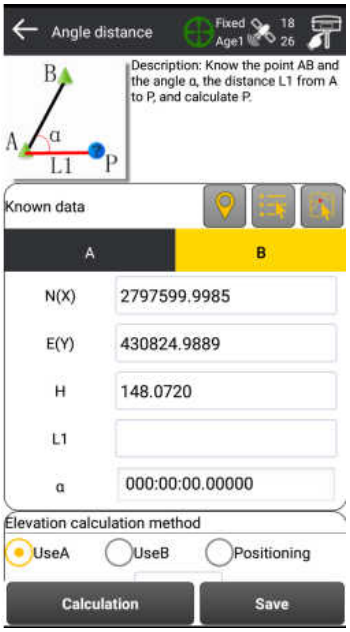


Figure 7.4-4

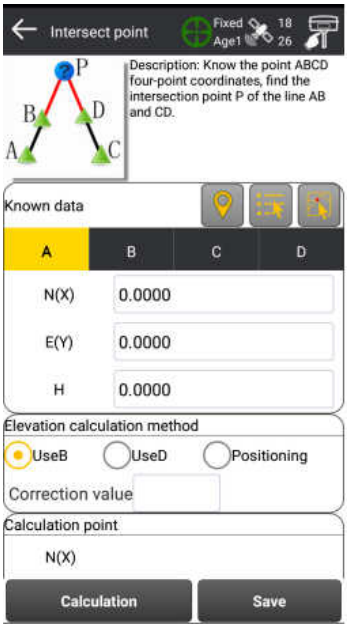


Figure 7.4-5

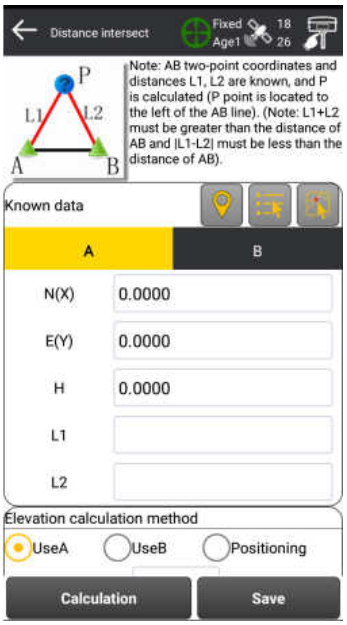


Figure 7.4-6

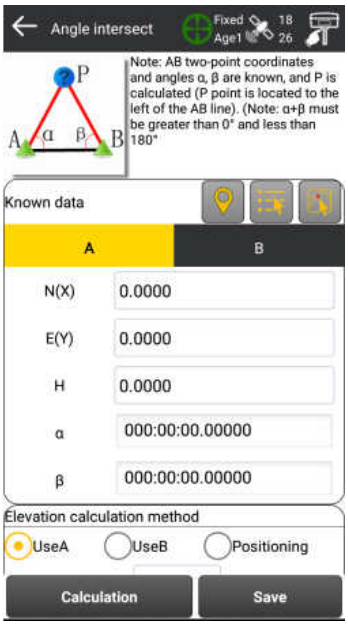


Figure 7.4-7

7.5 angle calculation

Calculate the angle between three known points, as shown in Figure 7.5-1.

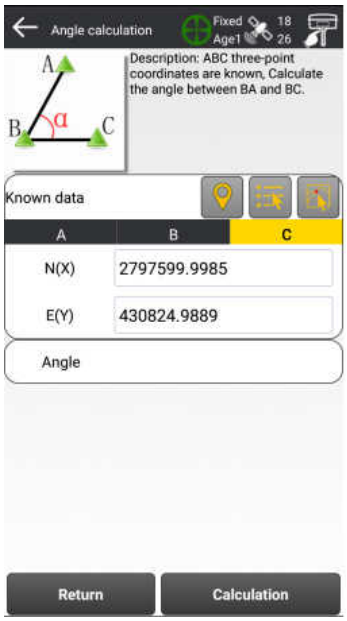


Figure 7.5-1

Figure 7.6-1

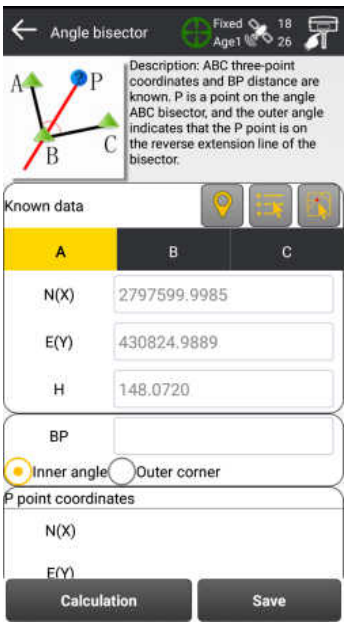


Figure 7.7-1

7.6 angle conversion

Provides unit conversion between radians, degrees, and degrees-minutes-seconds.

Refer to Figure 7.6-1. Enter the angle in any of the input fields to calculate the corresponding values in the other two formats.

7.7 calculate the angle bisector

Given three points and one distance, calculate a point on the angle bisector, as shown in Figure 7.7-1.

7.8 interpolation point

Calculate an interpolation point between two specified points. The interpolation can be evenly divided by specifying the number of points or by specifying the interval between the insertion points. As shown in Figure 7.8-1, select or enter the coordinates of the two points, input the number of insertion points, and click the calculate button to complete the interpolation point calculation. Click the save button to access the parameter save form, as shown in Figure 7.8-2. It can be saved as measurement points, layout points, or symbol blocks. After saving, the measurement points and layout points are stored in their respective databases, while the selected drawing symbol for the symbol block is stored in a graphic file.

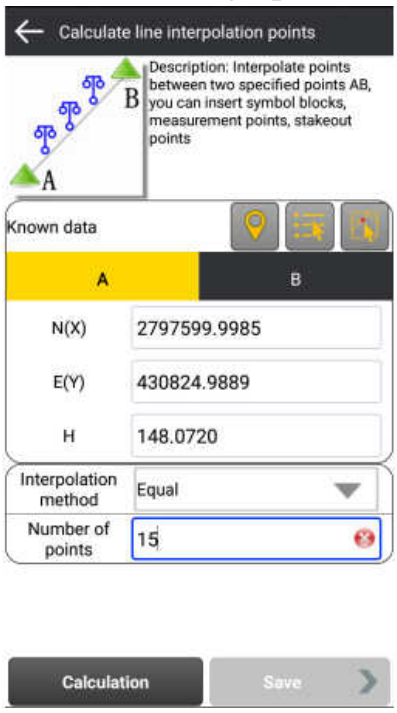


Figure 7.8-1

Figure 7.8-2

7.9 fill point

Fill points within a specified range of lines based on the input interval. The filling content can be measurement points, layout points, or symbol blocks. You can draw a polyline for filling on the graph or select an existing polyline for filling

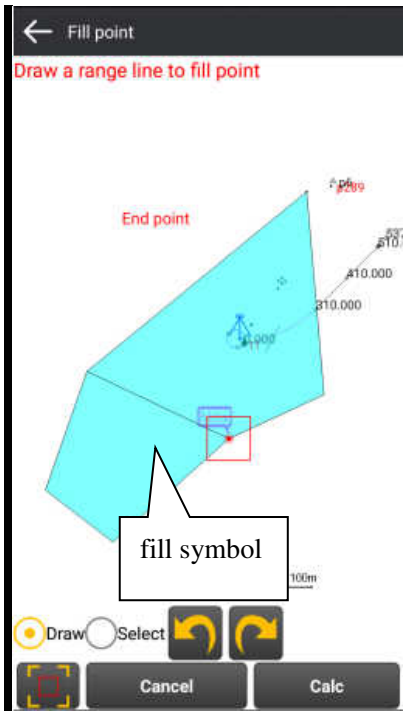


Figure 7.9-1

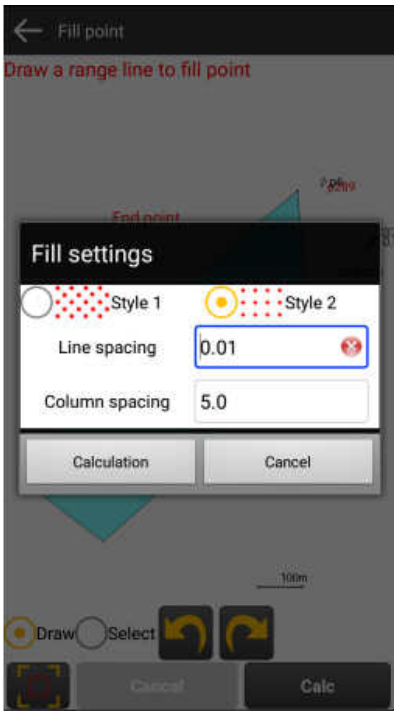


Figure 7.9-2

[Draw Line] It is the same as drawing a polyline. Click or swipe on the graph to draw a polyline. When drawing is completed, there is no need to close it to the first point. Simply click the [Calculate] button, and the polyline will automatically close and the fill parameter dialog box will pop up, as shown in Figure 7.9-2. During the process of drawing the polyline, you can perform undo and redo operations. Click [Cancel] to cancel the ongoing drawing of the polyline.

The product manual includes two types of filling patterns. Pattern 1 only requires inputting the fill interval, while Pattern 2 requires inputting row and column intervals. Click the [Calculate] button in the dialog box to complete the calculation of fill points. A pop-up interface for selecting insertion point types will appear, as shown in Figure 7.9-3. It allows filling of measurement points, layout points, and symbol blocks.

[Save Points to File] You can save the calculated coordinates of the fill points as a

dat text format in CASS.

[Keep Boundaries] Specifies whether to retain boundary lines when manually drawing multiple line segments for filling.

Figure 7.9-3

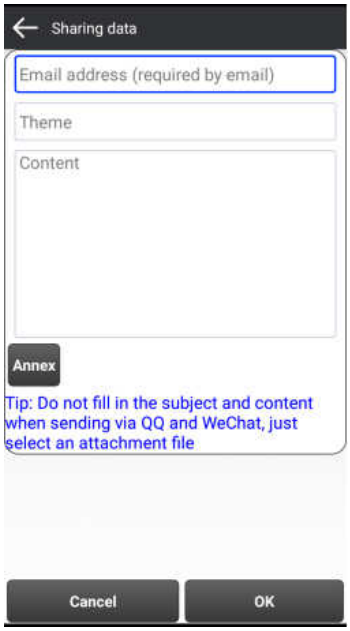


Figure 7.10-1

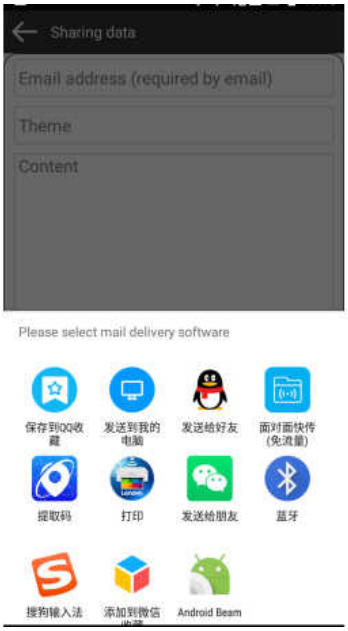


Figure 7.10-2

[Undo] and [Redo] only undo or redo the points of the currently drawn multiple line segments. The symbols of the fill cannot be undone here. You can undo them in the measurement drawing interface.

[Select Lines] Fill calculations can be performed by selecting existing line segments on the diagram. Only one line segment can be selected at a time. It is also possible to fill if the selected line segment is not closed.

7.10 Share data

Data sharing is the process of sending data through third-party software, as shown in Figure 7.10-1. You can use the pre-existing email software on your phone to send emails, or you can send files through platforms such as QQ, WeChat, and others.

When sending via email, the email address must be filled in, while the subject and content can be optional. Only one attachment file can be added. Click the

[Confirm] button to prompt the file selection dialog to appear. Choose an email software, and at this point, you will need to log in to an email account in order to send.

When sending via QQ and WeChat, there is no need to fill in the subject and content. Simply select an attachment file and click [Confirm] to share it with friends or send it to a computer.

7.11 transferring files via FTP

Without a data cable, you can wirelessly transfer data to a computer through a local area network (LAN). Open the FTP function interface as shown in Figure 7.11-1. The handheld device and the computer must be connected to the same LAN. The handheld device should be connected to Wi-Fi, while the computer should be connected to the same LAN's router or Wi-Fi network. Click the [Start Service] button to create an FTP service. Then, enter the address displayed on the handheld device into the "My Computer" address bar on the computer, as shown in Figure 7.11-2 and Figure 7.11-3. After entering, press Enter to view the folders on the handheld device and copy the exported files to the computer.

Figure 7.11-1

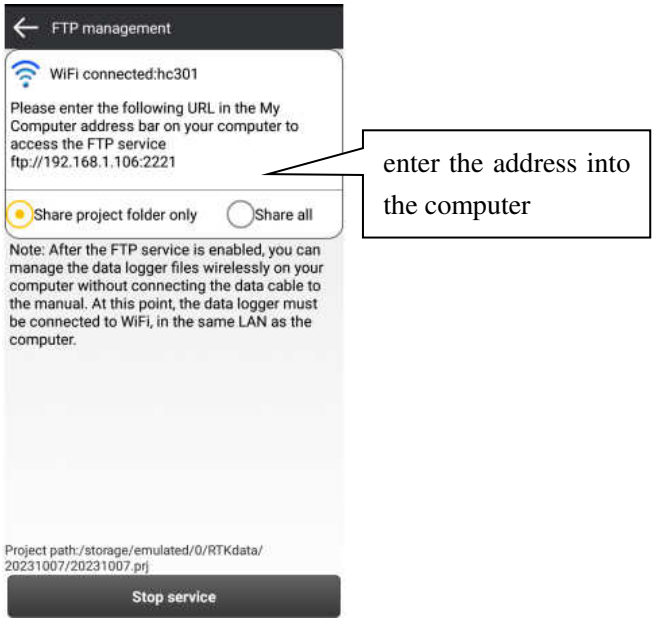


Figure 7.11-2

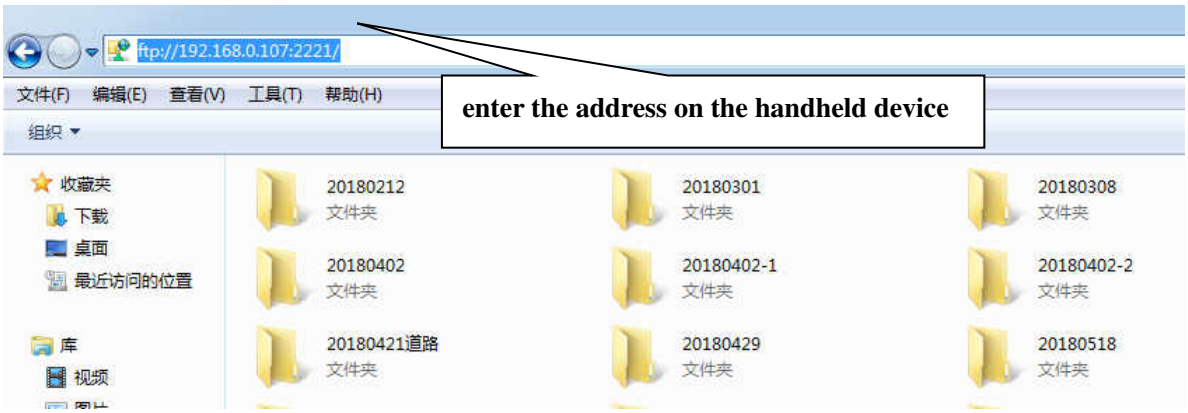


Figure 7.11-3

Selecting [Share Project Folder] allows you to navigate to the path where the handheld device's projects are saved, making it convenient to quickly locate the project path. Choosing [Share All] will display all the folders stored in the handheld device.

Chapter VIII.Laser Measurement.

8.1 Laser Calibration

Step 1: Click on “Laser Calibration”

, as shown in Figure 8-1-1, to enter the laser calibration interface as shown in Figure 8-1-2.

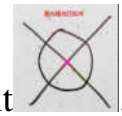
Step 2: Begin by clicking on “Laser Off”

Step 3: Select the measurement point

(the measurement point can be a known point acquired on-site using the instrument, or manually inputted using on-site acquisition or pre-manual input).

Step 4: Click on “Laser On”

.

Step 5: Align the laser device with the measurement point 
.

Step 6: Click on the measurement button

located in the bottom right corner (for laser measurement, it is recommended to perform measurements in two directions as shown in Figure 8-1-3). After completing the measurement, check the error value below as shown in Figure 8-1-4.

Step 7: Within the acceptable range of error, click on the "Save" button located in the bottom left corner

to confirm. (Note: It is recommended for users to perform measurements on known points using the laser for accuracy comparison before daily usage. If the laser measurement error is significant, it is advisable to recalibrate the laser.)

Figure 8-1-1

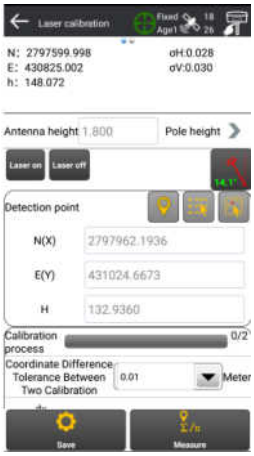


Figure 8-1-2

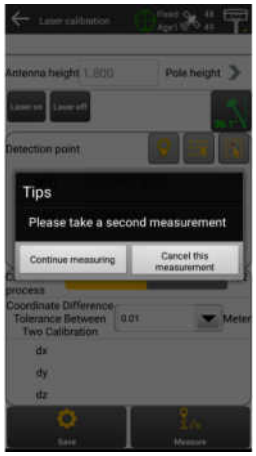


Figure 8-1-3

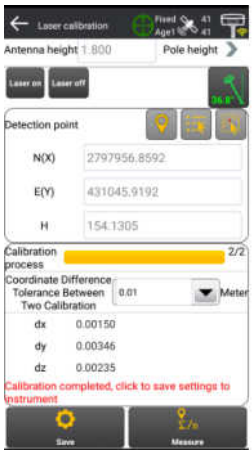


Figure 8-1-4

8.2 laser ranging

Click on the "Laser Ranging" [1] as shown in Figure 8-2-1 to enter the laser ranging interface as shown in Figure 8-2-2. Use the laser to aim at the measurement point, click on "Measure," and the distance from the bottom of the machine to the laser measuring point will be displayed as shown in Figure 8-2-2.

Figure 8-2-1

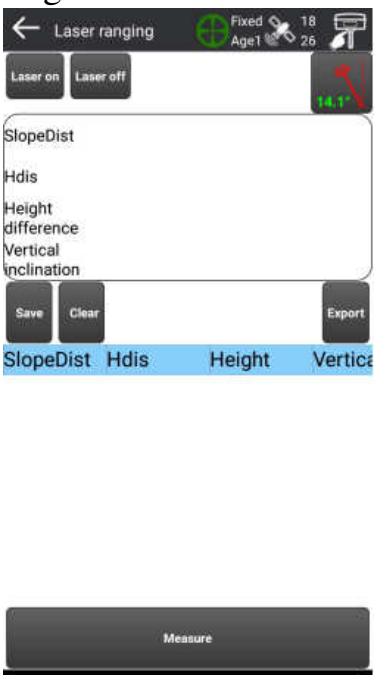
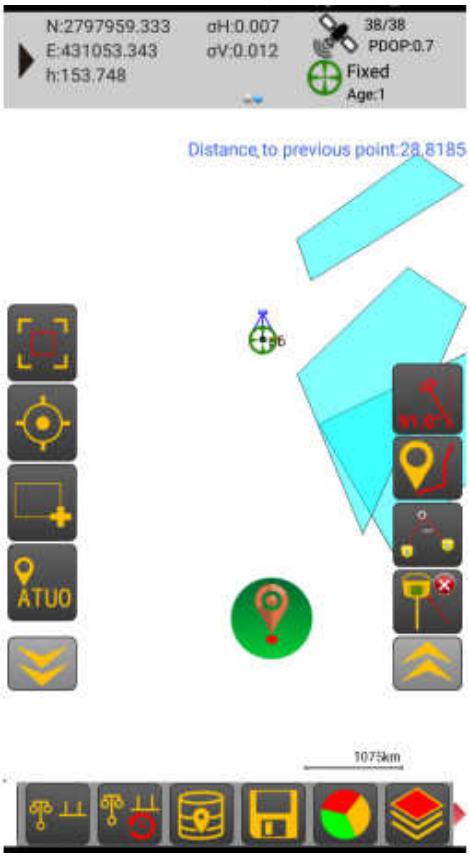


Figure 8-2-2

8.3 laser measurement coordinates system

Click on the “Measure and Drawing”

, click on the laser icon in the bottom right corner to activate the laser. Once the laser is activated, the icon will change to a checkmark . Begin by aligning the laser to the points that need to be measured. Click on the “Measure and Collect” button to collect the measurements. Once the collection is completed, save the data.



Chapter IX.Inclination Measurement

9.1 Tilt Calibration

Click on the "Tilt Calibration"

button to enter the tilt calibration interface (as shown in Figure 9-1-1). Set the correct pole height

and click on the "Calibrate Centered Pole"

at the bottom to begin the tilt calibration (as shown in Figure 9-1-2). Follow the prompts to calibrate in all four directions (as shown in Figure 9-1-3). Once the calibration is complete, click on the close button (as shown in Figure 9-1-4). (Note: It is recommended that users regularly perform accuracy checks to ensure that the inertial navigation accuracy is within 30MM. If the accuracy exceeds the limit, it is advisable to recalibrate the tilt. If the centering pole is replaced during instrument use, it is also recommended to redo the tilt calibration.)

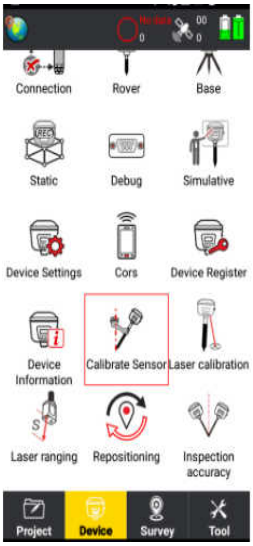


Figure 9-1-1

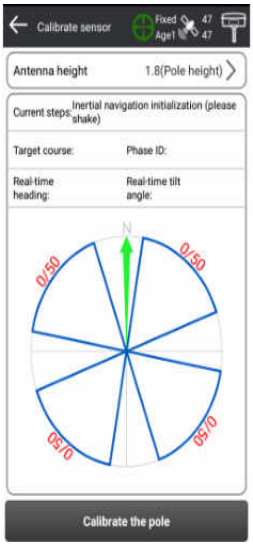


Figure 9-1-2

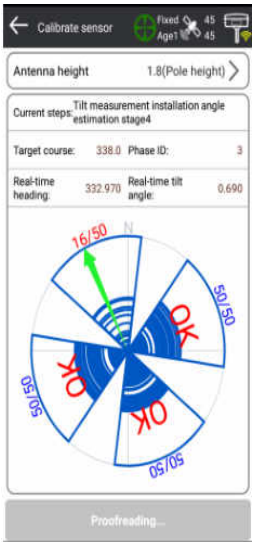


Figure 9-1-3

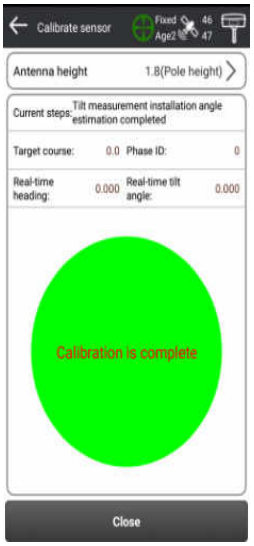


Figure 9-1-4

9.2 Precision Inspection

Click on the "Open Precision Inspection"

(as shown in Figure 9-2-1), set the correct pole height

(as shown in Figure 9-2-2), click on the "Start"

button, and use the centering pole to tilt in four directions as prompted to collect data. After collecting the data, check that the error value at the bottom is within 30MM to determine if it is qualified (as shown in Figure 9-2-3).

Figure 9-2-1

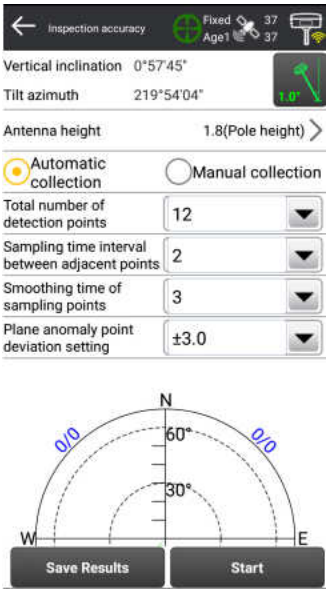


Figure 9-2-2

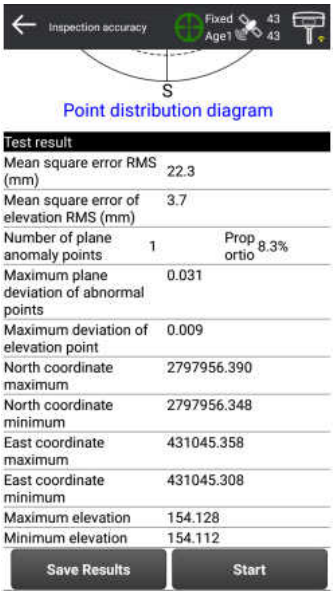
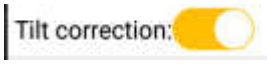


Figure 9-2-3

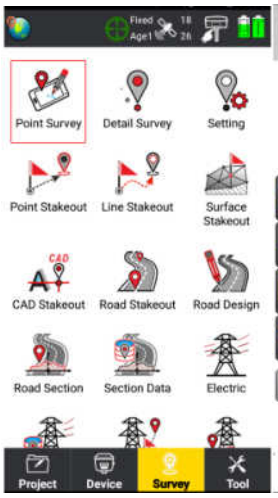
9.3 Tilt Measurement Usage

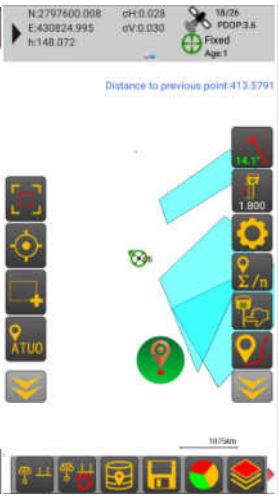
Click on the "Measurement Drawing"

(as shown in Figure 9-3-1), click on the "Tilt Measurement" icon
(as shown in Figure 9-3-2) to open the tilt

correction 

(as shown in Figure 9-3-3). This can be used in various measurements or layout tasks (as shown in Figure 9-3-4).





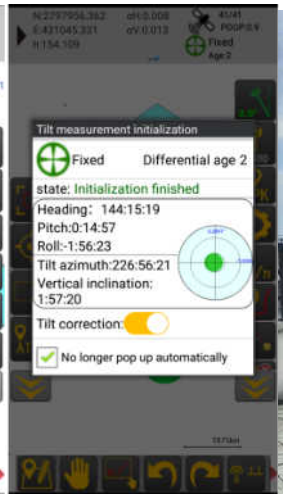


Figure 9-3-1 Figure 9-3-2 Figure 9-3-3 Figure 9-3-4

Appendix 1.File Format

1、file format

[*.prj] Handbook Project File (Binary Format)

[*.pot] Measurement Point Library File (Binary Format)

[*.fyp] Layout Point Library File (Binary Format)

[*.kzd] Control Point Library File (Binary Format)

[*.gsc] Graphical File Stored in Handbook (Binary Format)

[*.bak] Backup File (Binary Format)

[*.csv] Excel File (Text Format)

[*.line] Line Library File for Linemaking (Binary Format)

[*.tin] Surface Library File for Surface Modeling (Binary Format)

[*.poi] Intersection File for Road Measurement (Text Format)

[*.elm] Line Element File for Road Measurement (Text Format)

[*.pov] Longitudinal Profile Design Line File for Road Measurement (Text Format)

[*.crs] Cross-Section Design Line File for Road Measurement (Text Format)

[*.bps] Slope Design Line File for Road Measurement (Text Format)

[*.crsp] Cross-Section Point Library File for Road Measurement (Binary Format)

[*.dat] Southern CASS 7.0 (Text Format)

[*.dxf] CAD Graphic File (Text Format)

[*.fwx] Survey Area Boundary Line File (Text Format)

[*.area] Area Line File (Binary Format)

[*.trk] Walking Trajectory File (Binary Format)

[*.eli] Electric Power Measurement Auxiliary Line File (Text Format)

[*.elp] Electric Power Survey Measurement Point File (Binary Format)

[*.ele] Measurement Point File Exported from Electric Power Survey, Used for Power Post-processing Software (Text Format)

[*.ptr] Electric Power Measurement Tower File (Text Format)

[*.tfsp] Tower Foundation Section Measurement File (Text Format)

The text format can be directly opened with Notepad, while the binary format

needs to be exported to another text format using the manual before it can be used.

FCC Warning:

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Caution: Any changes or modifications to this device not explicitly approved by manufacturer could void your authority to operate this equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

The device has been evaluated to meet general RF exposure requirement.