

Application of GPS RTK technology in land survey and demarcation

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Abstract. The land survey is not only based on the professional quality of surveyors, but also optimized and managed by the corresponding technology, so as to improve the precision and accuracy of land survey. Survey and demarcation itself is a rigorous and highly professional job. In modern land survey and demarcation work, GPS RTK technology is needed to strengthen the accuracy of the work and ensure the optimization and improvement of survey data.

Keywords. GPS RTK technology, land survey and demarcation, application.

In the current land reform, requisition, planning, reclamation, consolidation, geological development and utilization, and further transformation of land function are required for different lands. These tasks are complex, and can only be completed by strong technological support. One of the key aspects is the survey and demarcation for land. During the survey, the area and geological condition of the land itself should be accurately measured while ensuring the subsequent topographic position and determining the area suitable for work [1]. These are conducive to the scientific management of national land and the improvement of the rationality of land management. GPS RTK technology can help enhance the accuracy and timeliness of technological survey and ensure that the technology development is becoming increasingly mature.

1. Main content of land survey and demarcation

In the survey work of the current buildings, a series of methods such as land allocation, requisition, transfer and use are main adopted for the investment of building projects, among which one key aspect is the division of building land and agricultural land; it is necessary to implement the demarcation of the land range and demarcate the local location by survey to guarantee the land rights and subsequent ownership. To this end, relevant departments need to carry out further survey activities after obtaining the approval of the institutions of land and resources, so that they can make effective application in the subsequent use, ensure the compliance of the survey of the whole project with the cadastral changes, realize the further evaluation, review and subsequent certification of land, and establish perfect and accurate basic data of situation analysis for the rational use of land itself.

It should also be noted that the main content of land survey is to determine the land boundaries and carry out the survey based on point position, divide the area of land based on this, and determine the ownership and main category of local land and then the future application of the land, providing scientific legal basis for the subsequent land use and the handling of land-related licenses; on this basis, corresponding data are collected for the land management departments, which can provide necessary actual data for subsequent department management [2].

During the survey, attention should be paid to the effective establishment of the boundary points; the work content of subsequent survey and demarcation and the corresponding basis are guaranteed on the basis of perfecting the land boundary, and the boundary points and mine nodes are effectively divided on this basis to ensure the accuracy and precise value of the whole boundary survey, so as to determine the size of the subsequent land used. Meanwhile, it should be noted that such survey can effectively use the existing surface to establish the perfect boundary between land blocks to ensure the orderly management of all kinds of land.

2. Main content and work pattern of GPS RTK technology

2.1. Main content of GPS RTK technology

GPS technology, which is familiar to people, is favored by people whether it is professionally used or as a civil tool. In general, GPS technology mainly positions satellite positioning signals using at least two GPS receivers, of which one is installed in a certain direction of a consistent location as a base point for the overall measurement, while the other is used to measure the actual distance and location of the point in the position and the GPS device is called mobile base station. Ordinarily, the main function of the base station is to establish perfect coordinates, and correct the data of the location of the mobile station after in-depth interaction with the mobile station; the mobile station mainly confirms its own location according to the feedback of the base station. This pattern can effectively improve the precision of GPS positioning technology and ensure that each location is unique [3].

RTK technology, which builds on GPS technology, is suitable for the analysis of carrier phase difference between base stations, and can efficiently process the carrier position difference between two stations and calculate the current position with a certain algorithm.

2.2. Work pattern of GPS RTK technology

The main work pattern of RTK measurement is based on the installation of GPS positioning system and data reception. We need to observe in the satellite observation pattern formed by GPS and collect the corresponding carrier phase to complete the final observation debugging to ensure that there is corresponding carrier in the base station; then, we transmit the response wavelength through the site in the base station, observe the carrier condition of the current GPS positioning in the mobile station, and observe the whole mobile base station with carrier phase to make it receive the response signals from the original base station, and conduct subsequent phase observation after debugging; while ensuring the interconnection of the overall technical carriers, we optimize the precision of carrier phase observation between two stations, effectively improve the accuracy of the overall observation, and ensure that the current location of the mobile stations can be measured [4].

In the work pattern of using RTK, the current data volume is used to achieve fuzzy initialization management, the RTK technology measurement is implemented while ensuring carrier phase and the distribution position of the current satellite is met, so as to ensure the data transmission and position management and measurement that can be optimized between the base station and the mobile station.

3. Key points in implementation of GPS RTK technology

3.1. Establishing an accurate baseline site

In the process of implementing the GPS RTK technology drill, the first condition of the operation of RTK technology is to complete the positioning measurement of RTK itself to ensure that there is a certain distance interaction between the mobile station and the base station during observation, and it can effectively decrease with the increase of the distance of base stations; it should be noted that the distance between two points should not exceed 5-10 km. The current RTK technology application in the domain pattern is that no matter whether the RTK technology system used is dual-frequency or single-frequency, they are differentiated by the radio transmission pattern signals. Therefore, when receiving the information from the corresponding base station, we should complete the final perspective work in the quasi-optical mode according to the antenna formed between the base station and the mobile station.

We should note that the measurement of RTK technology can be completed smoothly in gentle places, such as the plain, gobi, beach or coastal areas of rivers, lakes and seas which are relatively smooth and have no shelter. However, in cities with buildings, rolling hills or basins with sunken terrain, errors in the application of RTK technology occur easily, and they are caused by the geographical location. In such geographical location, it is easy to produce larger deviation in the final distance due to the elevation of the terrain itself. To effectively improve the precision of the RTK technology measurement, it is necessary to increase the distance from the base station to each mobile station, set up several evenly distributed coordinates around the base station in advance, complete the setting of the control points, and then establish a more precise base station, ensuring that there are no shelters above the base station and no satellite signals above the base station that produce unnecessary shelters; radio signals will interfere with the accuracy of RTK technology measurement, so it is necessary to increase the height of the antenna of the base station in the process of erection, so as to increase the accuracy of the selection of the base station.

3.2. Adopting coordinate parameters with high accuracy to solve by conversion

The ellipsoid pattern is positioned by GPS technology, the difference values between two ellipsoids are compared, the formula relation between the two ellipsoids is established, and finally the conversion of coordinate intervals is completed [5]. This helps to adopt this method of order of magnitude. Since there are also some errors in the national-level control network on the current ground, and corresponding parameter changes in different regions, it is necessary to conduct subsequent parameter transformation according to the coordinates provided by the local region and the basic parameters, so as to ensure that the corresponding coordinate system is in the same coordinate system without producing greater errors. In general, two sets of standardized coordinates are used to establish the data coordinate system, and then parameters are transformed to ensure errors are minimized. Besides, during the GPS measurement within the measuring area, we need to perfect the transformation of artificial parameters, and finally include two coordinate patterns in a unified coordinate system to complete the transformation [6]. In addition, attention should be paid to the same projection mode used in the current map, and effective parameter transformation is carried out by the same projection. In the process of completing parameter transformation, we should ensure that the base points are in a consistent position in the map observation process, and transform them with known parameters, so that we can ensure the accuracy of the final data.

3.3. Inspection before application of RTK technology

The reliability of the RTK technology measurement depends mainly on two aspects: the first is the reliability of data transmission, and the second is the observation environment around the mobile sites. To ensure the efficient use of RTK technology, locations of two stations are generally checked before survey to avoid that the satellite signals affect the transmission of data content. At the same time, parameters and data should be upgraded in time during the station detection to ensure the accuracy of data transmission, and the changes of surrounding environments should also be noticed and confirmed, so that the accuracy of the overall measurement during the RTK technology work.

4. Conclusion

The land survey and demarcation work itself falls within the scope of cadastral survey, so the cadastral survey is carried out to determine the scope of work in two aspects: on the one hand, the ownership of the boundary of the current land is divided according to the current administrative agencies and the corresponding governments; on the other hand, the ownership of local agricultural land, such as pasture and farming land, is further surveyed and demarcated by local governments.

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