

# Research on Surveying and Mapping Technology of Special Topography

Heng Zhao

National Land Surveying and Mapping Institute of Shandong Province, Jinan, Shandong, 250000, China

**Abstract:** In recent years, China's engineering start technology has achieved rapid growth, and various technical problems have also appeared in engineering development. Due to China's vast geography and different topography, various complex topography increases the difficulty of surveying and mapping, and also poses huge challenges for professionals. While fortifications cannot leave surveying and mapping, surveying and mapping in the face of the special terrain environment is more difficult. Surveying and mapping staff should select accurate survey methods and surveying techniques according to the specific engineering background, and conduct tests on some special terrains. The paper discusses the specific methods of surveying and mapping of special terrain, and briefly discusses the detailed application of special terrain, in order to improve the quality of surveying and mapping.

**keywords:** Surveying and mapping engineering; Special terrain; Surveying and mapping methods

**Citation:** Heng Zhao, 2020. Research on Surveying and Mapping Technology of Special Topography. *International Journal of Geology*, 5(1): 7-11. <http://doi.org/10.26789/IJG.2020.01.003>

**Copyright:** Research on Surveying and Mapping Technology of Special Topography. © 2020 Heng Zhao. This is an Open Access article published by Urban Development Scientific Publishing Company. It is distributed under the terms of the Creative Commons Attribution-Noncommercial 4.0 International License, permitting all non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited and acknowledged.

## 1. Introduction

In recent years, with the continuous development of science and technology, surveying and mapping engineering in construction technology has also ushered in new developments and breakthroughs. The professional term of surveying and mapping engineering is therefore well known by people. The field of application of surveying and mapping technology has gradually expanded. It is not difficult to see it from urban and rural construction, surveying and mapping of special terrain, to the development of mineral products. Contemporary surveying and mapping engineering technology has broken through the limitations of traditional technology and improved the accuracy of surveying and mapping for construction sites. For professionals who master surveying and mapping technology, the current surveying and mapping technology is to add science to the basis of traditional surveying and mapping. Innovation and technological research, the two complement each other, in order to better collect geological information and data related to special terrain.

Traditional surveying and mapping technology has gradually formed a technology for surveying and mapping of special terrain after years of practice and accumulation. Therefore, the surveying and mapping technology for spe-

cial terrain is far more sophisticated than the traditional surveying and mapping technology. In actual surveying operations, in the face of changeable terrain, the problem can only be solved if the measuring distance and height are well controlled.

## 2. Current Status of Surveying and Mapping Engineering for Special Terrain Surveys

### 2.1 The Shortcomings of Surveying and Mapping Engineering for Different Situations

Surveying and mapping engineering is currently widely used, and the problems encountered are not the same. Among the overall surveying and mapping projects, the most obvious embodiment of technical deficiencies is the surveying and mapping work carried out under special terrain and special environments. For example: how to maximize the use of land, and how to progress the land survey work for remote mountainous areas, etc. The distribution of cities in China is relatively extensive, and the changes in the natural environment between cities and the overall land form are relatively changeable and complex. This kind of complex terrain is extremely common in the plateau areas of China. Take the Loess Plateau as an example, where the soil is relatively soft and sparse. The structure

of the topography is also due to the special area, and there are more ravines and uneven terrain. When conducting surveying and mapping projects, there is a problem that the location of the railway cannot be clarified. If there is a large-scale natural disaster or heavy rain in the local area, it will cause damage to the railway equipment<sup>[5]</sup>. In view of different urban environments and natural factors, there are still many problems in surveying and mapping engineering that cannot be effectively solved at the moment, and professionals are required to continuously improve and explore the road of surveying and mapping.

## 2.2 Some Limitations in Current Surveying and Mapping Technology

For the current surveying and mapping projects, the most widely used are the digital surveying technology of total station and the GPS-RTK digital surveying technology. But with the continuous promotion of technology, people have gradually discovered some limitations and drawbacks in the application process. For example, in the process of engineering surveying and mapping, when using the total station surveying and mapping technology for construction, it is necessary to ensure that both ends of the equipment running measurement points are always maintained. The state of visibility is visible, and there is still a certain error in the measurement situation. With the increase of the measurement distance, the accuracy of the engineering measurement will gradually decrease, and it is difficult to guarantee the results of the surveying and mapping. The GPS-RTK digital mapping technology does not need to ensure the visibility of the two ends of the measuring point, and can complete the long-distance three-dimensional coordinate surveying and mapping work, which greatly reduces the error existing in the project. However, the scope of application of this technology has certain requirements on the surveying area, and only some areas with relatively spacious terrain and wide field of vision can be selected. Therefore, only the integration of traditional surveying and mapping technology and modern surveying and mapping technology can maximize the improvement by complementing each other. Work efficiency to achieve the ultimate surveying and mapping purpose.

## 3. Develop Effective Surveying and Mapping Measures for Different Special Terrains

### 3.1 Research on Surveying and Mapping of Lush Vegetation

When the surveying and mapping project encounters a mountainous area with relatively lush vegetation, the

signal of the surveying and mapping instrument will be interrupted due to the particularity of the area, and the signal link between the base and the mobile point cannot be realized, which directly leads to obvious errors in the measurement results. Such measurement results cannot be ignored. Used in engineering. As for the GPS-RTK mapping instrument, it will not work due to the interruption of the signal<sup>[6]</sup>. Because of the particularity of the terrain and vegetation, the measurement field of view of the total station survey instrument is blocked, so there is no way to come in handy. This requires the use of the third method of surveying and mapping to solve. Technicians need to take the lead in measuring and judging the precise straight-line distance between the location to be measured and the measuring station, and then combine the preset required wire points, the position of the stakeout point, the distance between the two, and the related angles, and cooperate with them. The mathematical formula is calculated to obtain the relative measurement result, and then the azimuth angle formed between the precise measurement position and the specific position of the to-be-fixed point is calculated through the calculation, and the relevant data is applied. Finally, the measurement method and the traditional surveying technology are used. Calculate the final accurate measurement value.

### 3.2 Surveying and Mapping Research for Muddy Mountainous and Desert Areas

Among the surveying and mapping projects, the muddy mountainous area is relatively one of the most common topography, which is similar to the desert and tidal flat areas in some areas. Therefore, generally speaking, the problems in surveying and mapping engineering are almost the same. When faced with surveying and surveying in muddy mountainous areas, our most intuitive idea is how to conduct on-site surveys. This is also the biggest challenge and test for professionals in terms of technology. In the face of this situation, the solution we formulated is as follows: Due to the particularity of the surveying and mapping area, it is impossible to use the relevant facilities and equipment to conduct on-site considerations, and can only rely on the third tool-the scope line. If the muddy area within the measurement range is extensive, the elevation must be used to improve the overall engineering survey work during the surveying and mapping process. The main measurement method is to set up measuring points on the outside of the muddy area to surround the area, and then use close-range photogrammetry technology or total station measurement technology to assist, so as to better ensure the accuracy of the measurement data and better follow-up work The proceeding<sup>[7]</sup>.

## 4. Overview of Surveying and Mapping Engineering

Surveying and mapping is an important part of engineering construction. In actual work, technical unreasonable and substandard situations often appear. Especially in the surveying and mapping work of special terrain, the problem is even more prominent.

### 4.1 Concept of Surveying and Mapping Engineering

Surveying and mapping engineering is a topographic map of information obtained by measuring space, topography, the shape of the earth and the gravity field as a basis. Surveying and mapping engineering has been widely used in the process of social development, such as surface photography, topography, hydrology, and mineral deposits. Under normal circumstances, for a region to grow, it must first be surveyed and mapped, and surveys and statistics must be done to ensure that the project can be carried out in an orderly manner.

### 4.2 Surveying and Mapping Work for Special Terrain Conditions

In actual surveying fortifications, the difficulty of surveying and mapping has increased due to complex terrain. Moreover, many people have misunderstood the existing surveying and mapping technology and traditional surveying and mapping technology, thinking that the two conflict with each other. But the fact is that the existing surveying and mapping technology is developed through the accumulation of rich experience in traditional surveying and mapping technology. The goals and essentials of the two surveying and mapping are basically similar. Both are a kind of information collection and shooting technology collected to understand the special terrain, with the goal of reducing the surveying and mapping time and improving the efficiency of fortifications.

### 4.3 Key Points of Surveying and Mapping Engineering

Total station surveying and digital surveying and mapping ceremonies are the most commonly used equipment, but there are still many problems in actual use. Specifically, the prerequisite of total station surveying and mapping is to ensure the visibility between the surveying point and the surveying station, and the distance will have a great influence on the accuracy of its surveying. Although there is no requirement in the design and operation of digital mapping, it is only suitable for relatively open areas. In some special areas, the measurement accuracy will directly decrease, and even the phenomenon of measurement

impossible. Therefore, traditional methods and modern methods can be combined together in actual surveying work to achieve mutual complementation and improve the efficiency of surveying and mapping work.

## 5. Difficulties Faced by Special Terrain Surveying and Mapping in Surveying and Mapping Fortifications

### 5.1 Equipment Problems

Special terrain mainly refers to some uneven terrain that brings inconvenience to normal measurement operations, special environmental terrain, such as forests and valleys with little human activity. The surveying and mapping affairs of this type of special terrain cannot be directly completed with existing technology and facilities. The most common technologies and equipment currently include aerial photography, photography, traditional measurement techniques, and leveling instruments. These technologies and equipment can complete accurate surveying and mapping when facing the usual terrain, but once faced with special terrain, they cannot be used normally. For example, in the jungle, the main difficulties in technology and equipment are caused by special terrain<sup>[1]</sup>.

### 5.2 Technical Issues

The technical difficulty refers to the workers, who need to have special facilities for measuring operations in complex areas, which puts forward higher requirements for the technical level of the staff. However, the existing surveying and mapping technicians do not have enough control over the new technology, and their knowledge of some new equipment is relatively limited. Moreover, because the surveying and mapping work mostly relies on manual operation, technical problems have become the main problems of fortifications.

## 6. Surveying and Mapping Schemes and Techniques for Special Terrain

### 6.1 Digital Surveying and Mapping Technology

Nowadays, with the rapid advancement of computers, digital surveying and mapping technology has been widely used in fortification surveying and mapping. It allows computers to be organically connected with surveying and mapping operations. The integration of geometric figures and numbers in actual operations can improve its technical level and integrate a variety of special terrain surveying and mapping. The information is solved digitally, and can be directly displayed in the computer by computer imaging processing. This technology can reduce the difficulty

of surveying and mapping, especially in special terrain surveying and mapping, and improve the accuracy of surveying and mapping.

## 6.2 Measurement Technology

With the development of GPS and RTK technology, it has gained a lot of application space in fortification surveying, and it can also help surveyors solve problems that cannot be solved by traditional surveying and mapping, and realize effective measurement.

## 6.3 Drawing Field Sketches

Because of the unreasonable calculations in the initial stage, the field sketches are often very confusing. In order to prevent the deviation of the drawing due to the inconsistent measurement of the point map, the surveying and mapping staff need to measure the corner points of the viewing room, and then use computer technology to make simple processing of the relevant data and information to simplify the field sketching process. After the visual summary map is formed, it should be printed according to the correct scale, and finally to the actual measurement site to draw a field sketch according to the on-site conditions<sup>[2]</sup>.

## 6.4 Data Collection

In the process of collecting data in the field, you can use a traditional measuring instrument like a total station. Because of its fast measurement speed and sensitive lens, it can collect data at the shortest distance. And these advantages are incomparable even with the best measurement methods. In order to ensure the final precision, the total station is generally used to conduct inconvenient surveying areas. However, because private houses often lock the door, surveying personnel cannot enter the house for on-site control. Both the TIK and the total station play an unfavorable role. To ensure accuracy, you should wait until the homeowner returns home before taking measurements. In this case, it is recommended to use other measurement points near the measurement area to quickly and easily complete the work on the measurement area, especially in some areas where the measurement is difficult to achieve excellent results<sup>[3]</sup>.

## 7. Technical Analysis of Special Terrain Mapping

### 7.1 Mapping of Densely Populated Urban and Rural Areas

Surveying and mapping workers with normal knowledge and technology know that the total station is the most

suitable network for this work data. It has the advantages of high efficiency in measuring distance, sensitive lens activity and can be used in various places. At the same time, it will not be disturbed by the space environment and can be close to the place to be measured to the greatest extent, which is not possessed by other equipment.

### 7.2 Mapping of Muddy Areas

It is very difficult to measure such areas when they encounter muddy and wilderness areas. If the surveying and mapping personnel do not understand the muddy area, it is difficult to obtain correct data and hinder the implementation of the overall project<sup>[4]</sup>. In this case, the staff can take the scope line to carry out specific work, take the muddy area as the center to layout to each measuring point, and take close-up photos or whole station instruments to make the data more accurate and achieve better surveying and mapping results.

### 7.3 Mountain Mapping

If the object of Surveying and mapping is mountainous terrain, we should consider the huge and lush plants, and the instrument loses its function due to the weak signal in the mountain, so we need to select good surveying and mapping instruments, and the measuring instruments of the whole station are not included in the scope of consideration. At this moment, we should use GIS and digital measurement technology to find the distance between the measuring station and the measuring point by constructing the coordinate system, Build the scale, substitute the data into the coordinates and azimuth of the measuring point, and then get the final value.

### 7.4 Topographic Mapping beyond Human Reach

In surveying and mapping of special terrain, the total station measuring instrument is generally adopted. Although this equipment is faster than other equipment and has flexible lens, the measuring instrument still has some dead corners and deficiencies, which is easy to be affected in some environments. In areas with large population, measurement is difficult or takes a lot of time. Timely use of GPS and RTK instruments can not achieve the expected goal. This instrument is simple and fast, which can ensure the measurement accuracy to the greatest extent and save the surveying and mapping cost.

### 7.5 Surveying and Mapping of Prosperous Areas of Forest Land

Forest is also the most encountered special area in the current surveying and mapping project. The prosperous

area of forest land is characterized by good concealment and difficult measurement, which will directly lead to the decline of measurement accuracy. In this regard, the following points should be paid attention to when surveying and mapping forest land. First, in surveying and mapping, pay attention to the interference of Surveying and mapping height angle to ensure its accuracy. Secondly, if GPSRTK technology is used for measurement, attention should be paid to the model strength of the instrument to prevent the measurement accuracy from being reduced due to too weak signal. Third, avoid the shelter of forest trees in the process of total station measurement. Fourth, it is difficult to complete the survey due to concealment. Traverse propulsion can be used for section survey to complete the specific surveying and mapping operation. In practical work, we should also pay attention to the correct instrument operation steps, and repeatedly determine all design calculations to improve the accuracy of Surveying and mapping.

## 8. Conclusions

Facing the rapid development of science and technology today, people's research work on surveying and mapping technology is still moving forward. Whether it is to improve surveying and mapping methods and methods as a whole, or to discover the shortcomings of the original technology, it is new to surveying and mapping breakthrough. The surveying method for special terrain still requires us to continuously explore the characteristics of the survey area and combine it with advanced science and technology to reduce the time and capital investment of surveying and mapping, break the special nature of the area, and lay a solid foundation for subsequent work.

With the rapid development of social economy, surveying and mapping operations have become complicated, especially terrain surveying has gradually become the main work area for surveying. We should learn advanced science and technology from other countries in order to improve China's level of surveying and mapping. , In

order to create more accurate data for the project. The paper analyzes the application of surveying and mapping technology and instruments in surveying and mapping work, and at the same time analyzes the surveying and mapping technology of mountains, forests, muddy and crowded areas. Based on the previous technical premises, it continuously improves and studies the actual surveying and mapping conditions in complex terrain conditions. It is hoped that the paper can help China's surveying and mapping technology to a certain extent.

## References

- [1] Wang Yaqi. Research on Special Topography Surveying and Mapping Technology Scheme in Surveying and Mapping Engineering[J]. Science and Technology Innovation, 2016, (08): 45.
- [2] Li Bowen. On the surveying and mapping technology of special terrain in surveying and mapping engineering[J]. Housing and Real Estate, 2018, (1X): 216.
- [3] Sun Xiaobing. Discussion on special terrain surveying and mapping technology scheme in surveying and mapping engineering[J]. China High-tech Enterprises, 2016, 360(9): 167-168.
- [4] Guo Lei, An Yongjian. Technical scheme of surveying and mapping of special terrain in surveying and mapping engineering[J]. Science and Technology Vision, 2013, (05): 201-202.
- [5] Wang Yaqi. Research on Special Topography Surveying and Mapping Technology Scheme in Surveying and Mapping Engineering[J]. Science and Technology Innovation, 2016(8):45.
- [6] Sun Xiaobing. Discussion on the technical scheme of surveying and mapping of special terrain in surveying and mapping engineering[J]. China High-tech Enterprise, 2016, 31(9): 161-162.
- [7] Zhao Hehe. On the analysis and research of surveying and mapping technical schemes in special terrain [J]. China Science and Technology Investment, 2017(3).