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Application of Several New Survey Methods in Detecting Air Raid Shelters

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Abstract

A large number of air-raid shelters were excavated all over the country around the 1950s. The construction of air-raid shelters played a vital role in protecting the lives and property of the people during the war. With the development of society and the advent of peacetime, more and more air-raid shelters are abandoned and are no longer taken seriously, and as time goes on, the impact of air-raid shelters on urban construction has become more and more obvious, resulting in more and more engineering accidents. more. It is of practical significance to strengthen the survey and evaluation of urban air-raid shelters in order to take reasonable and reliable measures. This paper introduces four survey methods for determining the buried depth of the air-raid shelter. Combined with the geological survey, the plane distribution, scale, buried depth, trend, distribution of the overlying soil layer and physical and mechanical properties of the air-raid shelter can be accurately provided. Provide support for air-raid shelter technical risk assessment and post-construction reconstruction.

Keywords

Air Raid Shelter; High Density Resistivity Method; Transient Rayleigh Method; Seismic Mapping Method; Geological Radar.

1. Introduction

Civil air defense refers to the state, according to the needs of national defense, mobilizing and organizing the masses to take protective measures to prevent and mitigate air strike disasters, referred to as "civil air defense". Civil air defense projects are caves dug to cover personnel and materials to avoid bombardment by enemy artillery fire and protect people's lives and properties in wartime [1].

With the development of society and the arrival of peacetime, a large number of air-raid shelters were abandoned. Since the Industrial Revolution, the progress of human science and technology and the economy has led to rapid development and changes in the process of global urbanization; cities have also undergone earth-shaking changes. Urban expansion and utilization of underground space are the needs of the current rapid urban development. The abandoned air-raid shelters in the city have become an obstacle to the development of urban construction. Air raid shelters are underground concealed projects. In addition, the air-raid shelters in the 1960s had no technical standards in structure. Some privately dug air-raid shelters were very simple and had many hidden dangers. Later, many air-raid shelters were backfilled during construction, especially for buildings or high-rise buildings, and the hidden dangers of air-raid shelters were eliminated when dealing with foundations [2]. However, most of the old air-raid shelter information is unknown, and the age of the air-raid shelter, the layout of the building, the scale, the depth and direction of the buried, the original design resistance and utilization are not known, which adds a lot of difficulties to the project. If it is not handled properly during the construction process, it is easy to cause collapse when there is too much rainfall, resulting in wasted investment or the safety and normal use of the upper building cannot be guaranteed [3].

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Therefore, it is an inevitable trend of social and economic development to survey the distribution of air-raid shelters in the site and evaluate their stability, and has very important value and significance.

2. New Method of Air-raid Shelter Survey

In actual work, it is extremely difficult to find the exact location of the air-raid shelter due to the loss of records and incomplete records at that time. According to the different hole-forming methods and tools, the following methods are used in the exploration of the air-raid shelter: well exploration, drilling, and geophysical exploration. In recent years, new technologies and new methods have emerged one after another in the visual exploration of strata, which provides a favorable means for solving this problem [4].

2.1 High-density Resistivity Method

The basic principle of the high-density resistivity method is exactly the same as that of the traditional resistivity method. It is based on the electrical conductivity difference of the rock and soil to study the distribution law of the conduction current of the formation under the action of artificially applied stable electric field, and then calculate the rock and soil. Stereo apparent resistivity, by studying the apparent resistivity change of the stratum, analyzes the lithology, structure, structure and other characteristics of the rock and soil layer. The high-density resistivity method is a resistivity geology tomography (Geotomography, GT) technology that integrates the advantages of the electrical profile method and the electrical sounding. The inversion result is a two-dimensional apparent resistivity section. It has the characteristics of high data density (dense point spacing), large amount of information and high work efficiency, and can more intuitively and accurately reflect the electrical cross-section characteristics of the measured geological body.

2.2 Transient Rayleigh Method

Rayleigh wave seismic exploration mainly uses two characteristics of Rayleigh waves: 1) the dispersion characteristics of Rayleigh waves when they propagate in layered media; 2) the close correlation between the propagation velocity of Rayleigh waves and the physical and mechanical properties of the medium. Rayleigh waves propagate along the surface, and the thickness of the surface layer is about one wavelength [5]. Therefore, the propagation characteristics of Rayleigh waves of the same wavelength reflect the changes of geological conditions in the horizontal direction, and the propagation characteristics of Rayleigh waves of different wavelengths reflect the geological conditions of different depths. On the ground along the propagation direction of the wave, set N+1 detectors with a certain track spacing Δx, the propagation process of Rayleigh waves within the length of N Δx can be detected. Let the frequency of Rayleigh waves be fi, the adjacent If the time difference of Rayleigh waves recorded by the detector is Δt or the phase difference is Δφ, the calculation formula of the propagation velocity of Rayleigh waves in the adjacent track length is:

$$V_R = \Delta x/\Delta t$$

The calculation formula of the average wave speed within the measurement range NΔx is:

$$V_R = \frac{N\Delta x}{\sum_{i=1}^{N} \Delta t}$$

By measuring the VR value of a series of frequencies in the same area, a VR-f curve can be obtained, that is, the so-called dispersion curve or converted into a VR -λ_R curve, where VR is the wavelength, and its calculation formula is:

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$$\lambda_R = V_R/f$$

The variation law of VR -f curve or VR -λ_R curve is inherently related to the underground geological conditions. By inversion and interpretation of the dispersion curve, the geological structure within a certain depth range and the Rayleigh wave at different depths can be obtained. Propagation speed VR value [6]. On the other hand, the value of V_R is related to the physical properties of the medium, according to which the physical properties of rocks can be evaluated.

2.3 Seismic Mapping Method

The ground extension mapping method is a geophysical prospecting method that uses the propagation law of artificially excited seismic waves in the underground rock and soil medium to study the reflection wave characteristics of different media under the condition of small offset, and to reveal the distribution state of the underground rock and soil mass [7]. A fixed offset is used for measurement, and the possible abnormal bodies in the ground can be judged according to the changes in waveform, frequency, amplitude and event axis of various waves such as direct waves, surface waves, acoustic waves, and reflected waves observed on the seismic record waveform.

2.4 Ground Radar

Geological radar uses ultra-high frequency electromagnetic waves to detect the distribution of underground media. Its basic principle is: the transmitter transmits a pulsed electromagnetic wave signal with a center frequency of 12.5M to 1200M and a pulse width of 0.1ns through a transmitting antenna. When this signal encounters the detection target in the rock formation, a reflected signal is generated. The direct signal and the reflected signal are input to the receiver through the receiving antenna, and displayed by the oscilloscope after amplification [8]. According to whether the oscilloscope has a reflected flood signal, it can be judged whether there is a measured target: according to the arrival delay time of the reflected signal and the average reflected wave speed of the target object, the distance to the detected target can be roughly calculated.

Because the detection of geological radar uses ultra-high frequency electromagnetic waves, its detection capability is better than that of detection instruments such as pipeline detectors that use ordinary electromagnetic waves, so geological radar is usually widely used in archaeology, basic depth determination, glaciers, groundwater pollution, mineral Exploration, diving surface, karst cave, underground umbilical detection, stratification, underground buried object detection, highway foundation and layup, reinforced structure, cement structure, non-destructive testing, etc. Using them can not only accurately determine the location of the air-raid shelter, delineate the range and trend of the loose belt, but also measure the relevant parameter values, and then calculate and evaluate the quality of the old cave and local instability, so as to decide whether to take remedial measures.

2.5 Determination of the Location of the Air-raid Shelter

The exact position of surrounding buildings and air-raid shelters was quickly measured by the total station, and then combined with computer and software such as AutuCAD, CASS, Tianzheng Architecture and other software to accurately draw, so as to realize the integration of internal and external digital mapping [9]. Basic steps: site reconnaissance - data collection - data processing - review and correction - map frame decoration - map output.

The field data acquisition is mainly to use electronic total station for traverse survey, the key is to measure the ground buildings and the underground air raid shelter together. Using the free set-up method of the total station, set the total station arbitrarily in a flat place with good visibility (A1), assuming that the azimuth angle from A1 to 4A of the hole pile is 4B (as shown in Fig.1), and measure 3 at the same time The above hole piles are for checking, and the rest can be drawn according to the design drawings. During the measurement, pay attention to the leveling and centering accuracy of the instrument when the light in the air-raid shelter is poor. The deeper the hole is, the more humid it is,

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and the measurement in the hole must be completed as quickly as possible, which is one of the reasons for pre-laying wire points in the hole during site surveys.

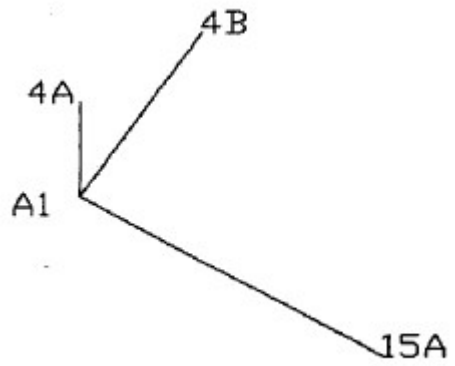

Fig.1 Total station free standing method to measure holes

3. Conclusion

In urban expansion, renovation, and construction of building foundations, it is often encountered that there are air-raid shelters within the scope of the design site. If such problems are not handled properly, investment will be wasted or the safety of the upper buildings and air-raid shelters cannot be guaranteed. It is necessary to comprehensively consider the relationship between the whole and the single unit, the ground and the underground, the building and the structure, the foundation and the foundation, and choose a reasonable solution to solve it. When surveying, evaluating and disposing of air-raid shelters, it is very important to adopt effective survey methods, select reasonable survey methods and adopt economical, rapid, safe and reliable disposal methods. On the basis of reading the relevant literature, the paper conducts a thorough and systematic research on the new method of underground air-raid shelter exploration. The method of determining the buried depth of the location of the air-raid shelter is introduced. Combined with the geological survey, the plane distribution, scale, buried depth, trend, distribution of the overlying soil layer and physical and mechanical properties of the air-raid shelter can be accurately provided. Provide support for the technical risk assessment of air-raid shelters and post-construction reconstruction.

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