# Analysis of nondestructive testing for buried depth of steel guardrail column

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**Abstract:** at present, there are two kinds of detection methods for the buried depth of the main steel circular columns in China: destructive detection method and non-destructive detection method. The destructive detection method currently adopts the pile pulling method. After the construction of the steel circular columns is completed, the detection unit will randomly sample a certain number of columns on site, and use mechanical equipment to pull out the columns to measure the buried depth; At present, the non-destructive testing methods mainly include shock elastic wave method and ultrasonic guided wave method, which can accurately and quickly measure the embedded depth of the column without pulling out the column after construction.

**Key words:** shock elastic wave;Non destructive testing;Accuracy;fast

Highway guardrail is an important facility for traffic safety, and the embedded depth of column is a key index of highway guardrail. In the process of vehicle collision with steel guardrail, because the steel guardrail has good crashworthiness and can absorb the energy generated by collision, it can greatly reduce the number of property losses and casualties caused by traffic accidents. According to the acceptance results of known expressways, most of the buried depths have met the requirements, but some projects still have quality defects, and the safety problem is worrying.

The most traditional method for detecting the embedded depth of columns is destructive detection, which is not only time-consuming and laborious, but also will damage the foundation slope. With the development of science and technology, researchers at home and abroad continue to research and innovate, and the detection technology for the buried depth of highway guardrail posts has developed rapidly. The gb-t24967-2010 national standard - shock elastic wave detector for the buried depth of steel guardrail posts has also been promulgated, which puts forward clear requirements for the principle, composition and accuracy of the test equipment, The non-destructive testing technology for the buried depth of steel guardrail column will become a new generation of testing means.

## 1 Test principle

Buried depth of columnThe shock elastic wave method is used to test the buried depth of the column, that is, the length of the column and the buried depth in the soil are calculated by using the reflection characteristics of the elastic wave, according to the elastic wave velocity of the interval automatically or manually selected by the instrument, and the time taken for the elastic wave to pass through the bottom of the column and reflect back and forth to the top.

In the measurement, the excitation device is used to send a pulse signal on the column head. The pulse signal emits elastic waves at the contact between the exciter and the column and reflects at the bottom of the column. The transmitted signal and reflected signal are received by the acceleration sensor connected to the instrument host, and then the length of the column and the buried depth in the soil are calculated

## 2 Experimental design

In this test, 9 embedded columns in steel circular soil were used. The embedded depth and length of columns in soil were measured by shock elastic wave method. Finally, the accuracy of the original embedded depth of columns was compared with the depth measured by the instrument and the embedded depth in soil.

## 3 Test process

1. during the test, the instrument shall be installed according to the installation sequence from the far end to the near end. During the test, two sensors shall be on the same straight line of the tested column. The first sensor shall be 10cm from the top and the second sensor shall be 60cm from the top. The sensor shall face the same position. If the data is not obvious or the displayed waveform is incomplete during the test, The sensor orientation can be changed again for testing. The sensor is connected with the instrument host through the charge cable, the upper sensor is connected with the CH0 interface of the instrument host, and the lower sensor is connected with the ch1 interface.

2. if the steel column has a column cap, it is necessary to remove the column cap and polish the top with a file, clean the rust and impurities, and then place the exciter. When placing the excitation head, remove the rubber cap first and check that the excitation impactor is located in the center of the hole. The installation of the excitation head should ensure that the excitation impactor is parallel to the test end of the column, and the excitation impactor hits the middle part of the test end face of the column.

3. after the installation of the instrument, carry out data acquisition. The waveform diagram should be representative and obvious during data acquisition. Take 8-12 valid data for batch analysis or manual analysis.

4. Data collection

The column used in the test is a steel circular embedded in soil, and 9 columns are randomly selected for column length test and buried depth measurement. The complete acquisition data waveform of column embedding depth detection is divided into three parts:

Reserved area: the embedded depth detector of steel column uses noise suppression technology to solve the impact of the surrounding environment on the detection. The flatness of the reserved area represents that the noise level of the surrounding environment meets the detection requirements.

First wave reflected wave: the first wave reflected wave represents the time signal when the excitation signal passes through the sensor. The excitation signal is triggered by the excitation head installed on the top of the column through electromagnetic control. The excitation signal passes through the sensor for the first time from the top of the column to form the first wave. Then the excitation signal reaches the bottom of the column, and then the acceleration is reflected upward. The second time, the acceleration sensor forms the reflected wave, The time difference between the first wave and the reflected wave passing through the sensor is the key to the analysis of the buried depth.

Period: the period is the process that the excitation signal is sent from the top of the column and reflected back to the top of the column every time. As the excitation signal propagates in the column and causes energy consumption, the amplitude of the signal will gradually decrease in a period.

5. data analysis

Analyze the collected data. In general, the collected elastic wave is automatically analyzed to directly measure the length of the column and the buried depth in the soil. If the automatically analyzed data does not have data, manually analyze it, manually calibrate the test interval, and manually analyze the selected interval. After having an accurate data, collect 7-8 effective waveforms, After the analysis, click the result preview to view the embedded depth of the waveform measured by the instrument and the length of the column.

(1) Automatic parsing

The clear head wave and reflected wave can be seen from the automatic analysis in Figures 1 and 2. The detection instrument will automatically extract the head wave and reflected wave and calculate their length. The detection instrument automatically extracts the calculated length of the first wave and reflected wave by combining the images of the upper channel and the lower channel. The result is 2.192m, which is 0.3% different from the actual length, and the test result is less than ± 4%, which meets the test accuracy requirements.

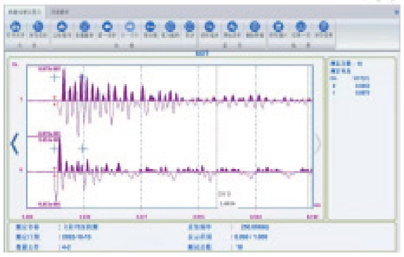
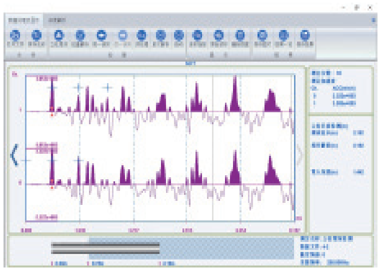

**Figure 1 automatic parsing** **Figure 2 Automatic parsing**

(2) Manual analysis

The automatic analysis of the detection instrument sometimes results in the error of automatically extracting the waveform due to the image, as shown in Figure 3 and 4. At this time, the analysis length needs to manually select the first wave and reflected wave.

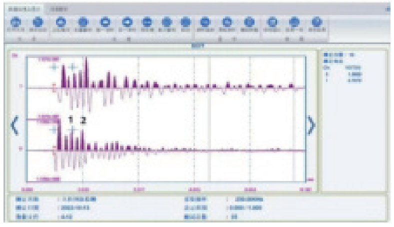
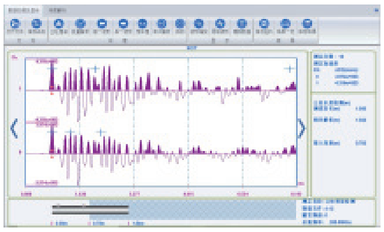

**Figure 3 manual analysis figure 4 manual analysis** **Figure 4**

Fig. 3 is an image collected by manually parsing the embedded column with the actual length of 1.80m, as shown in Fig. 3. It can be seen from the image that the error reflected wave automatically extracted by the detection instrument is the position of the number “1”, and the actual correct reflected wave position should be the wave of the number “2”.

Fig. 4 the “reflected wave” analytical image where the error number “1” is automatically extracted by the detection instrument through manual analysis, and the analytical length is 1.543m. The difference from the actual length is 14.3%, and the test results do not meet the requirements. (see Figure 4 for manual analysis)

At this time, it is necessary to manually analyze the length. First, change the “automatic” resolution method in the “processing” option above to “manual”, then use the right mouse button to select the reflected wave of the number “2”, use the left mouse button to select the location of the first wave, and click “single resolution”. At this time, the length of the detection instrument is analyzed according to the manually selected first wave and reflected wave, and the analysis result is 1.856m, which is 3.1% different from the actual length, meeting the requirements of test accuracy.

(3) Comparison between manual parsing and automatic parsing

Through this experiment, the deviation between the measured data by manual analysis and the test length by automatic analysis and the design length is -0.4%, 2.8%, which meets the accuracy requirements.

It can be seen that the manual analysis is more accurate than the automatic analysis, and the relative error is relatively small, but it needs to analyze one waveform by one. The automatic analysis is faster, but the accuracy is lower than the manual analysis. Therefore, the manual analysis can be carried out first to measure the first group of data, and the rest of the waveforms can be analyzed automatically, and finally the data can be compared, If the errors of the two solved data meet the specification requirements, the automatically parsed data can be recognized as the final buried depth and column length to improve the accuracy of the data.

(4) During this test, a total of 9 columns were collected, and the test results are shown in Table 1-1:

**Table 1-1 test results**

| Serial number | Test length (m) | Design length (m) | Buried depth (m) | Relative deviation | Serial number | Test length (m) | Design length (m) | Buried depth (m) | Relative deviation |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.140 | 2.200 | 1.391 | -2.8% | 6 | 2.150 | 2.199 | 1.448 | -2.3% |
| 2 | 1.440 | 1.400 | 0.686 | 2.7% | 7 | 1.720 | 1.760 | 0.995 | -2.3% |
| 3 | 1.790 | 1.797 | 1.042 | -0.3% | 8 | 2.450 | 2.400 | 1.712 | -2.0% |
| 4 | 2.380 | 2.350 | 1.617 | 1.2% | 9 | 2.480 | 2.453 | 1.730 | 1.1% |
| 5 | 1.780 | 1.800 | 1.057 | -1.1% | | | | | |

(5) Accuracy analysis

According to the above experiments, the average error is -0.644%, the maximum error is -2.8%, and the minimum error is -0.3%. According to the "shock elastic wave detector for buried depth of steel guardrail column" (GB / T 24967-2010), when the total length is less than 2000mm, the measurement deviation coefficient is not more than 5%; When the total length is greater than 2000mm, the measurement deviation coefficient is not greater than 4%, meeting the requirements.

## 4 Influencing factors

1. sensor

During the test, if the two sensors are not on the same straight line of the measured column and the sensor is placed at the column weld position, the accuracy of column data will be affected. During the test, if the magnet on the contact surface between the sensor and the column is not clean enough, there are iron filings or sand, it will also affect the accuracy of column data.

2. excitation device

During the test, the excitation device will also affect the accuracy of column data. Check whether the connection between excitation devices is normal. If the instrument is loose, it will cause great interference to the test of column data accuracy. During the test, the excitation head shall be perpendicular to the top axis to ensure that the excitation device hits the top of the column vertically to avoid the impact on the data accuracy of the guardrail columnAfter installation and commissioning, the top will be knocked with an exciting device. Generally, the knocking force should be selected between 20-30n. Further strength debugging will be carried out according to the column data image to ensure the accuracy of the test.

3. data analysis

During data acquisition, the collected waveform should have more than 3 cycles, the maximum value and gradual decline, and the elastic wave front has a reserved area. Only when these three basic conditions are met can the accuracy of the test column data be ensured. During manual analysis, the selected interval is representative and periodic. When selecting an interval, the first maximum value should be the starting point and the second maximum value should be the end point for manual analysis. Ensure the accuracy of test data.

4. external factors

Before the column is selected for testing, the column buried for no more than one year shall be selected for testing as far as possible to avoid the influence of older columns on the accuracy of accuracy results. During column test, if the bottom of the buried part of the column in the soil contacts with the medium such as large stones, it will affect the waveform of the column and affect the final accuracy and the buried depth. During the test process, the surrounding environment should be kept quiet to minimize the impact of the environment on the accuracy.

## 5 Conclusion

This experiment uses the shock elastic wave method to detect the buried depth of columns, which has many advantages such as fast, economical, nondestructive and effective reduction of signal noise. Accurate calculation of the length and buried depth of embedded columns in soil plays a positive role in ensuring the quality of the project. A complete detection system is formed through various data acquisition and analysis systems. In this experiment, The impact elastic wave method for measuring the circular column of steel guardrail accurately reflects the buried depth and length of the column, and improves the accuracy of the data. With the development of shock elastic wave method, the safety and reliability of expressway operation will be effectively improved, the occurrence of traffic accidents will be reduced, the safety of people's lives and property will be protected, and outstanding contributions will be made to the development of Expressway in China.

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# Research on the integration and application of Zhuang cultural clothing and contemporary Guochao brand from the perspective of intangible cultural heritage

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**Abstract:** Guangxi Zhuang culture is not assimilated by the Central Plains culture because of its special regionality, and its cultural uniqueness also affects the traditional clothing. Zhuang cultural clothing has become a cultural treasure of intangible cultural heritage because of its unique patterns and production techniques. “Guochao” is a new brand that combines the excellent traditional culture of the whole Chinese nation with the trend culture. It organically combines the traditional Zhuang clothing culture with the modern trend clothing, which is not only conducive to the innovative development of the clothing industry, but also plays a very positive role in promoting the dissemination of the intangible cultural heritage culture of the Chinese nation, This paper studies the positive significance of the application of Zhuang culture clothing elements in “Guochao” clothing, and how to apply Zhuang culture clothing to Guochao clothing, for reference.

**Key words:** National tide;Intangible cultural heritage;Cultural clothing

## Introduction

Among many ethnic minorities in China, the Zhuang Nationality in Guangxi has become a wonderful flower among them. The Zhuang nationality has a large population, wide geographical distribution, and great differences in lifestyle. It has formed diversified national characteristics in the long historical development and changes, which has also created its unique clothing cultural connotation. Zhuang costumes are rooted in the soil of Zhuang culture and contain the unique spiritual temperament and thinking mode of Zhuang people. They are not only the “living fossil” of Chinese national history, but also provide rich resources for the study of Zhuang history and the inheritance of intangible cultural heritage culture. At the same time, the exquisite and unique design also provides inspiration and ideas for modern

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