Study on the application of infrared water detector in the geological prediction of tunnel

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Keywords: Infrared water exploration; tunnel; advanced geological prediction; nine Peng inclined shaft.

Abstract: This paper takes Jiupeng Creek inclined shaft tunnel, located in Wuxi village, Nanyang town, Zhangping City, as the research object, using the infrared water detector on the cross section of the tunnel and tunnel face of geological forecast detection, and according to the analysis of the infrared water detector section and tunnel face test data, the geological conditions of tunnel are effectively predicted later, engineering of tunnel has a good guiding role to carry out.

1. Principle of infrared advanced water exploration

The detection of concealed water bearing structures by infrared rays is first determined by the thermal conductivity of the water itself. Water conductivity rate lower than the thermal conductivity of all rocks, the underground excavation near horizontal space, if there is a water bearing structure, the water bearing structure in the water, whether the hydraulic contact layer around the tunnel Bureau site, because the water conductivity rate is very low, it was hard to rock temperature assimilation. As far as its specific heat is concerned, the specific heat value of all rocks is lower than that of water. This shows that the heat capacity of any kind of geological body is not as large as that of water, and the water can maximally store cold, moderate and hot temperatures. And because the thermal diffusivity of water is lower than that of all rocks. Therefore, from the outer space strata to the hidden water bodies at the excavation level by tectonic migration, the water temperature in the original space can be maintained to maximum extent, so there is always a significant temperature difference between the hidden water bodies and the rock temperature. The geothermal field theory that geothermal field is a constant value, when the excavation space around the water structure, normal temperature field background water bearing structure field will be superimposed, so that the normal geothermal field distortion, the other also shows that the infrared energy will follow long hair. According to Stephen - Pohl Seidman law, the energy of the infrared band radiated by the medium and the temperature of the target will be changed significantly. Therefore, hidden water bodies in surrounding rock of tunnel excavation can be found by using infrared water exploration technique.

2.Tunnel and geological survey

The choice of tunnel is nine Peng Xi slope, located in Zhangping City, Nanyang village Wu Xi village, is the auxiliary tunnel nine Peng Xi tunnel, the flat, mostly woodland, roads connected, traffic is convenient, the length of 1039m, the slope rate of 7.86%, in line with the direction of the line intersects with DK179+040. Small plane line mileage direction angle of 120 degrees. Nine in the exit section of Peng Xi tunnel, the surface is scattered with Qel+dl silty clay, brown and yellow, hard plastic and thick 1~3m; coarse breccia soil: purple red, dense, slightly wet, gravel diameter 2~5cm, distributed in the surface of the tunnel exit. Lower to whole weakly weathered T3d siltstone, brown yellow, purplish red, and bluish gray. Strong weathering is earthy, thick about 1.2~7.2m; strong weathering is fragmental; the rock mass is broken and thick 15~35m; the following is weak weathering.

3.The detection method of cross section and tunnel face

3.1 After entering the tunnel, the probe sequence number is firstly arranged

（1）The purpose of the survey is to determine whether there are any concealed water bearing structures or caves within 30 meters of the excavation. The two objective is to determine whether there are concealed water bodies or water cut faults or karst caves within 30 meters of the outer space of the tunnel. To achieve the above two objectives are accomplished by N detection line and face detection data difference. The name of this N detection line are: the left corner detection line, the left wall detection line, vault detection line and right wall detecting line, right corner detecting line, bottom center line detection etc.

（2）Methods: detection section, arranged to face as a starting point, to the tunnel behind every 5 meters on a side wall section, mark detection, a total of 12 standard no.. When the infrared detector is plotted, the first end represents section 001, and the tail end represents section 12. The computer mapping, the 001 section of the data on the left, 12 data points on the right side, as the relative detection curve, the first end of said field is 01 points, the end of said field is 12 points. (12 point mark near the working face of the side wall, from the bottom of about half the height.)

3.2 Infrared detection along tunnel direction

The operators are standing next to each section of the tunnel in turn, respectively, to detect N different space locations and to store the detected values. Then go to the next section number and do the same. Specific practices are as follows:

（1）Before the official detection, the equipment should be set up well. The specific method is to connect the instrument power supply, enter the information items in the main menu, check the date and time. On the other hand, enter the settings item in the main menu to select whether or not to turn on the laser. When the light in the tunnel is good, as long as the laser is on.

（2）After completing the above work, you can enter the official probe. At this point, the operator should stand at the center of the tunnel next to the No. 001 section number, enter the section measurement in the main menu, and the LCD screen will be transferred from the main menu to the measurement screen.

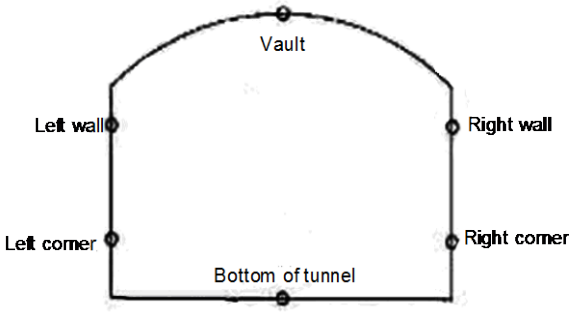


Fig. 1 sectional drawing of tunnel

3.3Face detection

The purpose is to determine the tunneling working face of the front water fault and fracture zone, karst development section. On the working face of the probe arrangement as shown in Figure 2, the level in the face direction of the cloth 4 lines, each line 6 points

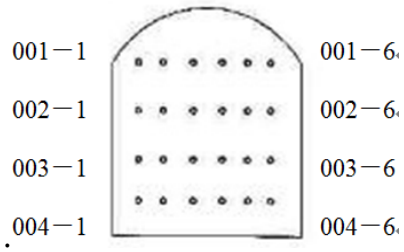


Fig.2 On the working face of the probe point layout

4.Test data analysis

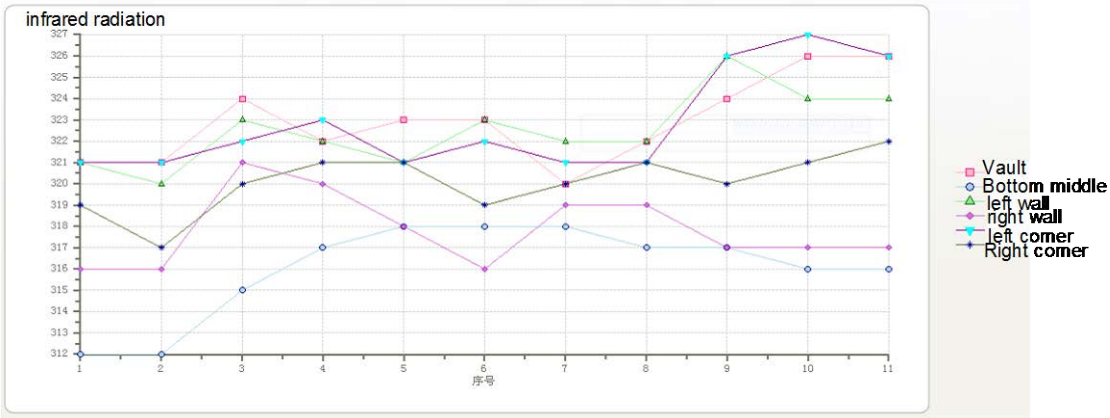
4.1 Cross section test data analysis

（1）Cross section test data sheet (45 meters long)

Serial number	Vault	floor	left wall	right wall	left angle	Right angle	X range
1	321	312	321	316	321	319	9
2	321	312	320	316	321	317	9
3	324	315	323	321	322	320	9
4	322	317	322	320	323	321	6
5	323	318	321	318	321	321	5
6	323	318	323	316	322	319	7
7	320	318	322	319	321	320	4
8	322	317	322	319	321	321	5
9	324	317	326	317	326	320	9
10	326	316	324	317	327	321	11
11	326	316	324	317	326	322	10
Yrange	6	6	6	5	6	5	6

Cross section data analysis shows that: X range data and table 1 in the front and tail, and is close to 10um/c square meters beyond the security value, said the right wall, the water bearing bodies in the floor area obviously. 2, although there is no super Y poor security value, but the range is too large (section test people back to the face)

（2）Section test data curve



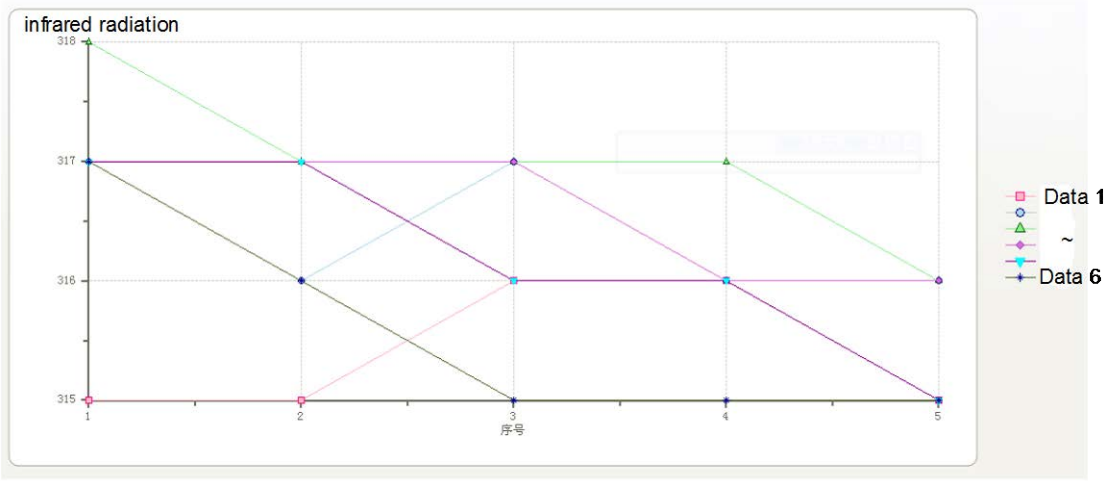
4.2 Face test data analysis

（1）The face test data sheet

Serial number	1	2	3	4	5	6	X range
1 line	315	317	318	317	317	317	3
2 line	315	316	317	317	317	316	2
3 line	316	317	317	317	316	315	2
4 line	316	316	317	316	316	315	2
5 line	315	316	316	316	315	315	1
Y range	1	1	2	1	2	2	1

Data analysis shows that: the face value close to face data and the right wall and floor (face test, on the face)

（2）Face test data curve



5. Conclusion

Through the above data analysis and the curve chart shows, the right wall and the bottom board contain the water area obviously. Also in line with the view in accordance with the entity, face and bottom water flow is obviously, the right wall wetting. Therefore, after the test, the treatment of the tunnel should be on the right side of the wall to pay attention to the protection; the face on the right wall side of excavation, it is important to notice beware of flooding.

6. Acknowledgments

This work was financially supported byScientific research project of Hunan Provincial Education Department. (Number: 16C1049)

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