Trial Inspection of Finished Dimension by 3D Laser Scanner

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Trial inspection of mountain tunnels includes measurements of the cutting face, excavation surface, and tunnel support structure from the cutting face, and the lining behind the cutting face. The former is to confirm the margin of construction and the thickness of shotcrete at the cutting face, excavation surface, and shotcrete surface. The latter is to confirm the thickness of the bore displacement of the tunnel and lining thickness. We tried using a 3D laser scanner to digitally inspect the finished dimension of Kawabe Daini Tunnel in Wakayama prefecture, and these are our findings.

1. Digital System to Inspect Finished Dimension

The digital inspection system of the finished dimension consists of Pet'sS, which surveys the face of the construction cycle using a laser scanner and processes, analyzes, and displays color-coded point cloud data, and Pet'sL, which surveys the BL unit of the lining behind the face and processes and color-codes the point cloud data. The configuration of the system is shown in Figure 1.

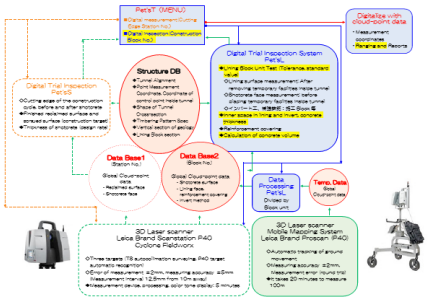

Fig. 1 Digital Final Dimension Inspection System

2. Inspection of the Final Dimension

The digital inspections of the final dimension of the construction cycle of the cutting face was basically to be performed twice, before and after the shotcrete was applied. The point cloud data was color-coded on a PC screen after inspecting the excavation surface, shotcrete surface, and thickness of the shotcrete. The bore displacement of the tunnel was inspected in BL units. Inspection was done with the point cloud data displayed in color. The color tone display of the bore displacement of the tunnel is shown in Figure 2. As a result of the above inspection, it was confirmed that the difference from the target values for the excavation surface, face, and shotcrete surface during the construction cycle is displayed in color in real time, enabling quantitative and efficient confirmation of the final dimension. In addition, it was confirmed that the point cloud data stored in the data base in global survey coordinates can be color-coded and displayed on the PC screen for measurement in the bore displacement of the tunnel.

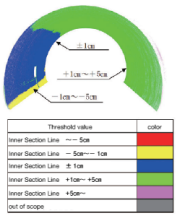

Fig. 2 Color-coded Display of Bore Displacement of Tunnel

3. Conclusion

This method not only enables real-time visualization, quantification, and reproduction of the final dimension of tunnels, but also has the advantage of significantly reducing the time required for inspection, especially in the case of long tunnels. We plan to continue to apply this method, conduct trials, identify issues, improve it, and develop it into a final dimension inspection technology for mountain tunnels.