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The Self-compacting Concrete Tunnel Lining System

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1. Background

The construction of tunnel lining has some issues.
First, in terms of the social environment in Japan, the birthrate is declining, and the population is aging. Therefore, we are facing the problem of a shortage of skilled workers.
Next, in terms of the working environment for tunnel lining, compaction of concrete and shifting of concrete pipes are carried out in a very narrow space.
And in terms of quality, there is a possibility of concrete defects due to human error caused by the lack of skilled workers or by working in narrow spaces. Furthermore, in the conventional method, it is very difficult to prevent surface bubbles at the lower part of lining due to the difficulty of air releasing at the lower part of lining.

2. Developed System

With these backgrounds, we have developed a new construction method to improve productivity and to save manpower.
In this system, we place the self-compacting concrete through the injection hole installed at the bottom of tunnel lining formworks and fill it without compaction or shifting pipes.
We proved the usefulness and high completion of the system through the full-scale construction test conducted at the testing ground of Sato Kogyo Technology Centre. And we applied this new method to actual road tunnel construction project in 2023. Only three workers were needed to construct the tunnel lining. There were no segregation or unfilled areas. No surface air bubbles were observed.
This demonstration in actual project site proves the feasibility of improving productivity and manpower-saving for tunnel lining construction.

3. Outlook for the Future

To make this system general-purpose, we will continue to make the concrete low-carbon and low-cost and to improve the equipment and structure of the tunnel lining formworks, with the aim of fully automating tunnel lining in the future.

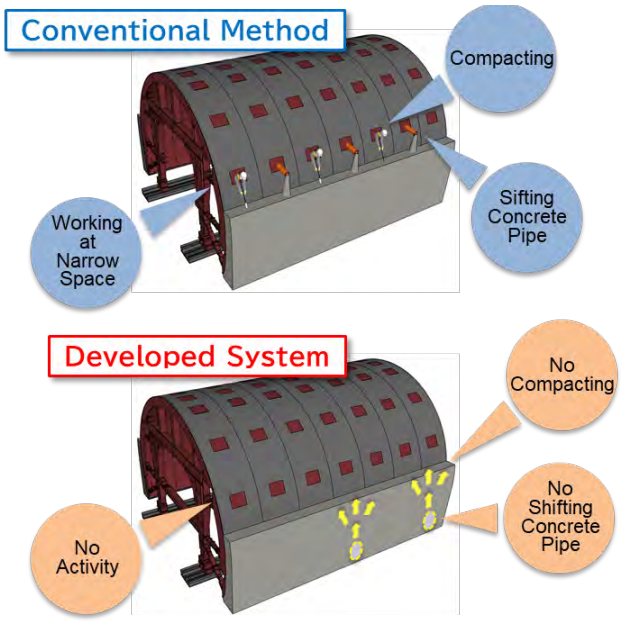

Fig. 1 Comparison of Conventional Method and Developed System

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Automatic B-measuring System T- RIPPA BK Improved Safety and Productivity through LPWA Radio

TAISEI CORPORATION

T-RIPPA BK is a cable-free automatic B-measurement system for mountain tunnel construction, to evaluate the stability of surrounding ground and the design adequacy of support members (Figure 1). The acquired data is sent from a compact data logger (Fig. 2), which is capable of LPWA communication and requires no external power supply, to an LPWA receiver installed in the tunnel. The distance between the data logger and receiver can be separated by up to several hundred meters, and the data logger with a protective plate that does not block radio waves is installed in shotcrete, so it is not damaged by blasting. This is a highly productive system that eliminates the need for labor-intensive process of cable protection and blasting protection of the equipment.

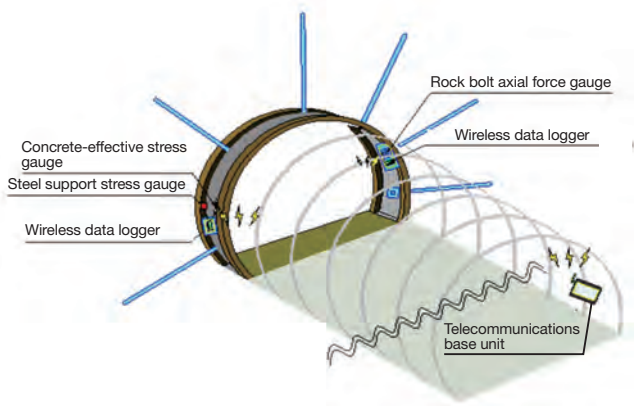

Fig. 1 Equipment configuration of T- RIPPA BK

Fig. 2 Data logger with LPWA

Fig. 3 Equipment installed

T-RIPPA BK is applicable at a level comparable in cost to B-measurement using conventional cables. The system also contributes greatly to the safety and productivity of B-measurement, with shorter installation time of the measuring equipment and considerable reduction of risks associated with working near the face.