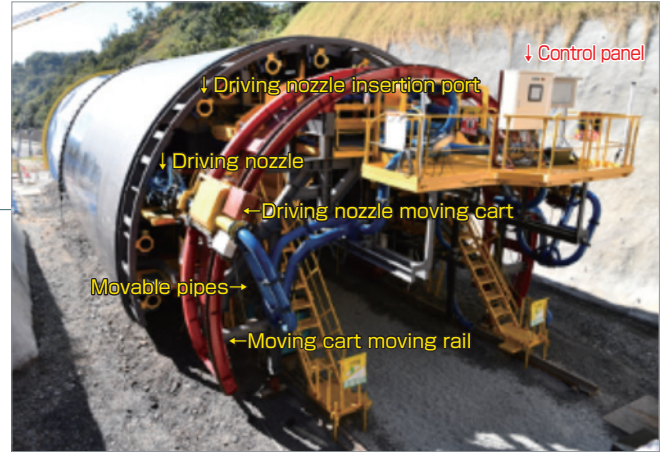




# Concrete tunnel lining Automatic construction robot system

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## Automatic concrete tunnel lining construction robot system achieves high quality concrete linings

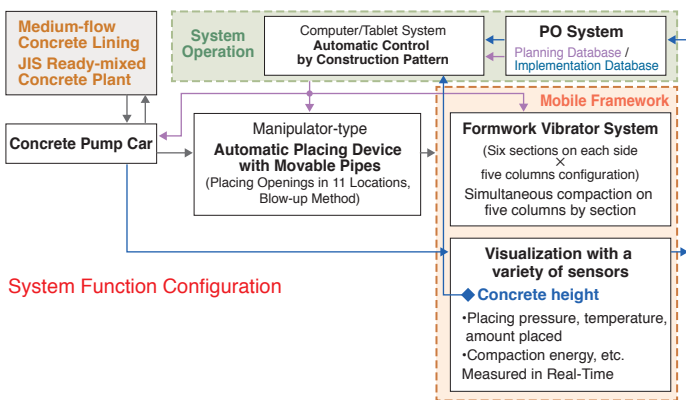


Full view of the system

### Outline of automatic concrete tunnel lining construction robot system

The automatic concrete tunnel lining construction robot system automatically controls the progress of a series of operations, from placing, compaction, stopping, and demolding of concrete lining used in mountain tunnels. It consists of a manipulator-type placing device and a computer system that controls the formwork vibrator automatically.

A characteristic of this technology is that it is an automatic construction method that makes use of the flow characteristics of medium-flow concrete lining. Fresh concrete with excellent fluidity and no material separation is automatically poured using the blow-up method into the movable formwork using a computer-controlled concrete pump and a manipulator-type placing device, and the pattern is automatically compacted using a formwork vibrator. The construction status and compaction status are constantly quantified and visualized by various sensors, which makes it possible to determine when to move on to the next section and enables automatic operation.



System Function Configuration

### Development background

Concrete lining in mountain tunnel construction has until now depended on the experience and intuition of skilled workers, and ensuring the quality of construction has become a serious challenge. As many of these skilled workers begin to retire, there is also a need for measures to reduce the workload of concrete lining construction as skilled workers are most needed for placing and

compacting concrete in narrow spaces. This is the reason for developing a machine that mechanizes the work of placing and compacting the concrete lining, in order to free workers from tedious work and dramatically improve the quality and speed of tunnel construction.

### Results gained by introducing the system

The introduction of this system enables the construction of dense, solid, and high-quality concrete lining that reaches the target quality, has no variation in strength distribution and surface properties, and has a good surface finish.

With the mechanical construction via computer system, manual work is replaced by mechanical work, and the role of the workers changes greatly, to that of checking the construction status and monitoring the system

### Future developments

The accumulated measured data will be analyzed and developed into a learning-type automatic concrete lining construction system that can respond to changes in the properties of fresh concrete, which will be developed into a common technology for mountain tunnel lining, and contribute to the establishment of lining technology.

### On-site implementation

As of December 2020, the system has been installed at three sites (total 911m, 9,257m3), and there are plans to introduce the system to many more sites in the future.



System operation screen

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