

# Multiple-lining Method

## Total Construction Method for High-Quality Tunnel Lining

### 복공 멀티공법 고품질 터널 복공을 위한 토털 공법

The multiple-lining method is designed to improve the quality of the concrete construction work for lining concrete. It systematizes the entire process, from concrete placement to compaction and curing, through the combined use of eight development technologies.

	Name	Function	NETIS registration
1	High-quality tunnel lining system for crown compaction	Compaction	TS-030008-A
2	Float vibrator system (vibrator with sensor)	Compaction	
3	Horizontal pumping placement method for the crown part	Placement	
4	Concrete filling pressure management system	Placement	
5	Parasol 30 mist method	Curing	In progress
6	Partition balloon curing system	Curing	
7	Labor saving and manpower saving system	Placement	
8	Magonote (Backscratcher) method	Compaction	

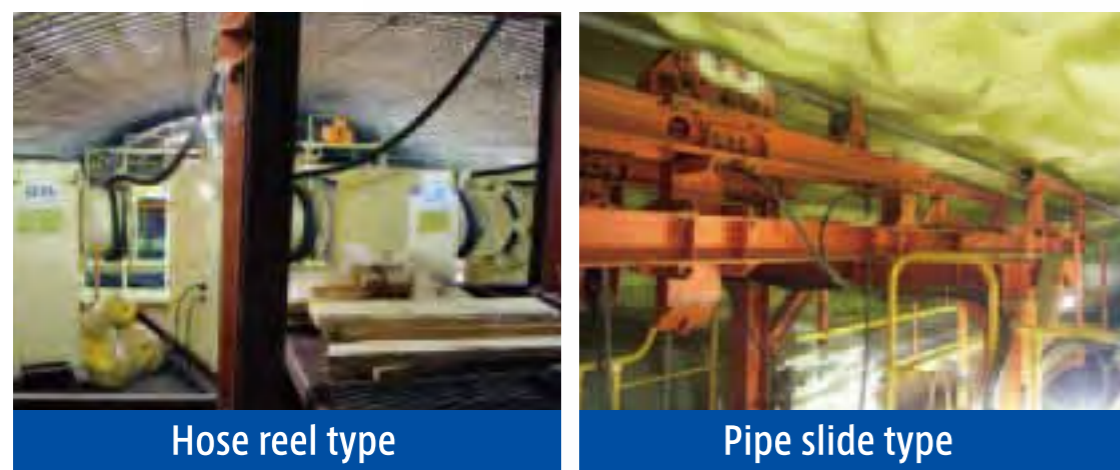


Center in the multiple-lining method

## Overview of the Multiple-lining Method

### 1 High-quality tunnel lining system for crown compaction

A method for inserting the vibrator in the crown in advance, and then performing compaction as the vibrator is pulled out following the completion of concrete placement.



### 8 Magonote (Backscratcher) method

A method for creating a vibrator insertion hole (φ100mm) in the inspection window of the crown part, and then compacting the surrounding areas by inserting the bar vibrator several meters simultaneously following the completion of concrete placement.

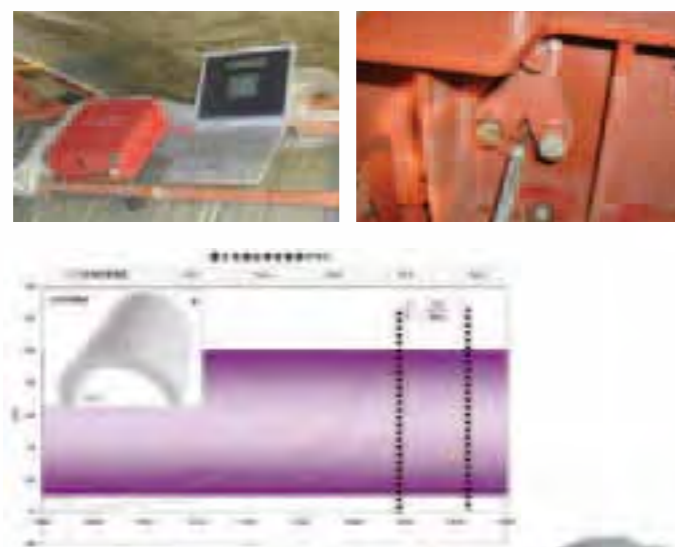
### 5 Parasol 30 mist method

The frames for the light pipes are hung from the lining crown, and are tightly covered with sheets to create a mobile parasol. 5-micron mist is sprayed at high pressure inside the mobile parasol, filling it with moisture to provide for sufficient moisture curing.



### 4 Concrete filling pressure management system

This system consists of a placement management system in which a pressure sensor is installed in the center crown part. Concrete placement is carried out while the concrete filling pressure is checked on a real time basis on the PC screen.



### 6 Partition balloon curing system

To limit the dry contraction cracks caused by ventilation after the tunnel is fully opened, two ventilators continuously pump air to the balloon installed at the center of the tunnel.



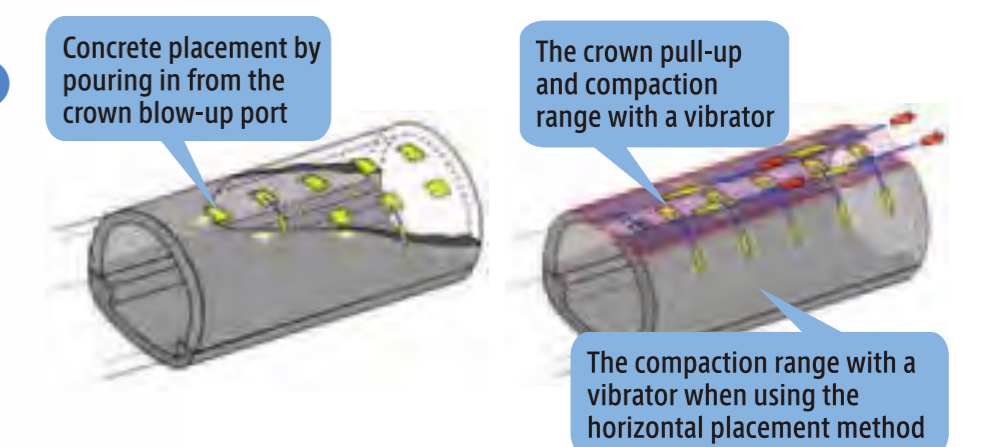
### 7 Labor saving and manpower saving system

This system is designed to save manpower by remotely operating the concrete pump car and changing pipes through the use of two cameras and four monitors.



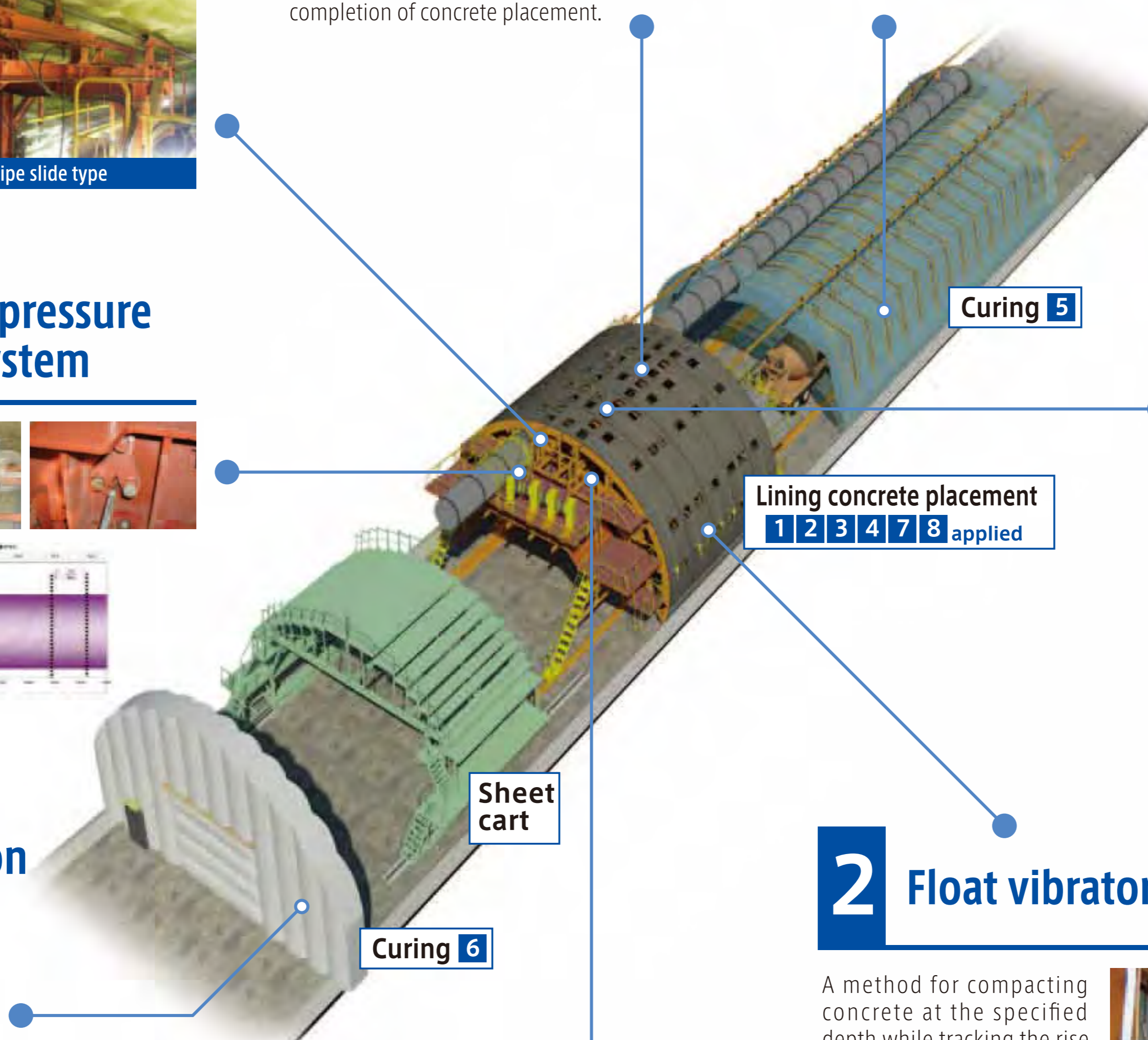
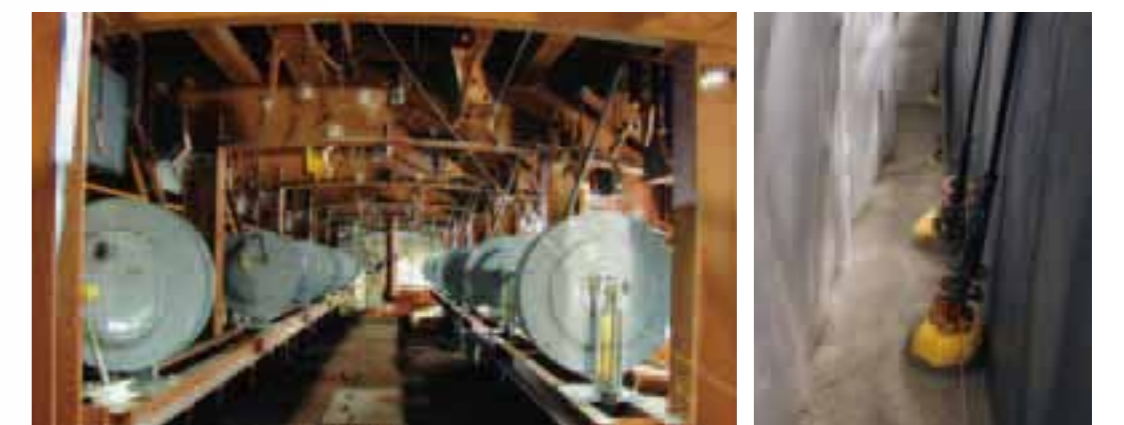
### 3 Horizontal pumping Placement method for the crown part

A method for creating four placement holes with the hydraulic opening and closing valve on the arch shoulder part, and then alternating the horizontal placement left and right on the gable side and wrap side.



### 2 Float vibrator system

A method for compacting concrete at the specified depth while tracking the rise of the concrete placement side by using a float set at the top of the bar vibrator.



## Construction Work History

Construction Work	Order placed by	Extension(m)	Construction period
Fukuoka No. 201, new construction of the Karasuo tunnel, first phase construction	Ministry of Land, Infrastructure, Transport and Tourism	929	2005/12~2008/02
Fukuoka No. 201, new construction of the Karasuo tunnel, second phase construction	Ministry of Land, Infrastructure, Transport and Tourism	615	2006/09~2008/01
Higashi-kyushu Expressway (Kamae-Prefectural boundary), new construction of the Uranosako tunnel north	Ministry of Land, Infrastructure, Transport and Tourism	819	2008/02~2010/03



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