

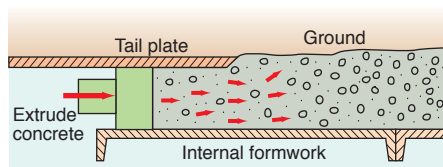
# Extruded Concrete Lining Method

Constructing high-quality linings / Providing high cost performance

## Characteristics

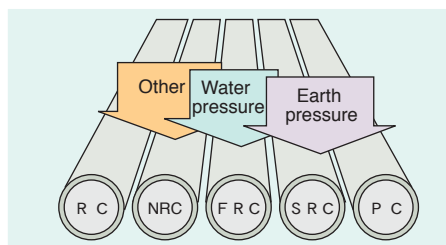
### 1. Construction of high-quality linings

Denser concrete with greater strength enables the construction of high-quality concrete linings.



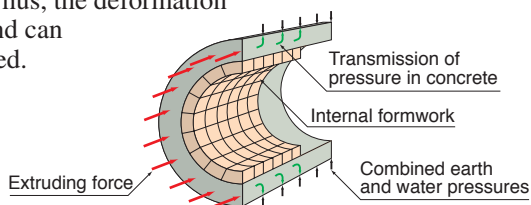
### 2. Linings with a broad range of applications

This method enables rational construction of concrete linings according to the site condition such as reinforced concrete, nonreinforced concrete, fiber-reinforced concrete, steel-reinforced concrete and prestressed concrete linings.



### 3. Minimization of ground settlement

Lining concrete is extruded, as the tunnel advances, by the pressure force corresponding to combined water and earth pressures. Thus, the deformation of the ground can be minimized.



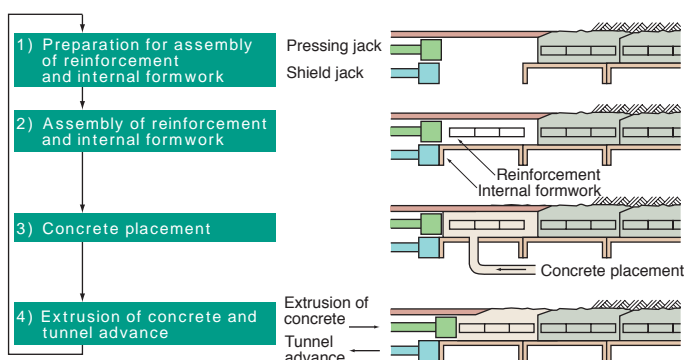
### 4. Saving of construction time and cost

The type of lining can be selected according to the geological condition, and secondary lining can be eliminated depending on the use of the tunnel. Construction cost therefore can be reduced and construction period can be shortened.

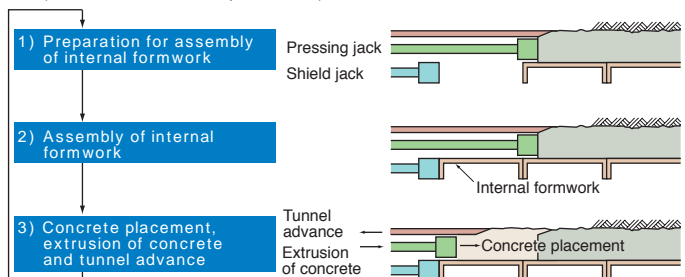
## Mechanism of tunnel driving

Construction flows by lining reinforcement method

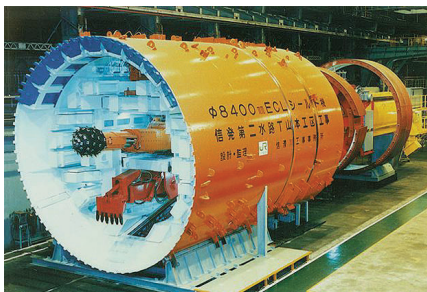
### 1. When reinforced concrete is used (cyclic concrete placement)



### 2. When nonreinforced concrete is used (continuous concrete placement)

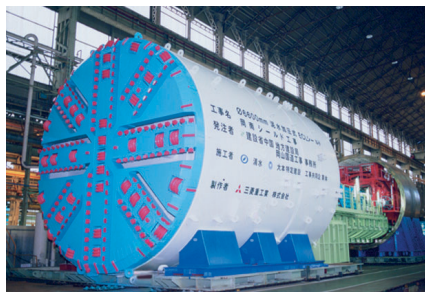


## Applications to actual tunneling



Diameter □ : 8.40 m  
Construction length: 3,100 m  
Major soil type: Sandstone and siltstone  
Use: Waterway

▲ Construction of the second Shinano-gawa water tunnel



Diameter: 6.60 m  
Construction length: 1,860 m  
Major soil type: Diluvial gravel □ layer  
Use: Utility conduit

▲ Konan shield tunneling



Cross section: 10.70 m wide □ and 9.92 m high  
Construction length: 3,805 m  
Major soil type: Tuff  
Use: Railway

▲ Construction of the east side of the Akima Tunnel on the Hokuriku Shinkansen railway line



Diameter: 3.99 m  
Construction length: 6,082 m  
Major soil type: Lava and mudstone  
Use: Floodway

▲ Main civil engineering work as part of the construction of new Hidaka power plant