

P&PC Segment Lining Method

(Prestressed & Precast Concrete Segment)

Excellent economy and high quality are realized by introducing prestress

Characteristics

1. Economic efficiency

Because segments are integrated into one piece by introducing prestress, joint metals can be eliminated. Also, the volume of reinforcement to obtain the same bending performance can be largely reduced as compared with reinforced concrete structures.

2. Quality

Cracking in the concrete can be suppressed by introducing prestress. Furthermore, a segment that has excellent smoothness and water-tightness with small deformation of the lining ring during assembly can be achieved because radial joint gaps are very small.

3. Resistance to internal pressure

For tunnels subjected to high internal water pressure, concrete can be held in a fully compressed state by introducing prestress, ensuring stability and water-tightness.

4. Smooth intrados

The segment has an interior with little roughness and no metal on the surface. It is highly water-tight, and cracking can be suppressed by prestressing. It is thus suitable for a single-pass structure without secondary concrete lining.

5. Earthquake resistance

By using unbonded prestressing strands in the tunnel longitudinal direction, earthquake resistance can be improved such that the lining structure retains pliability and follows underground deformation during an earthquake.

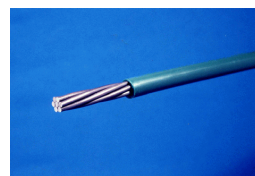
6. Buildability

Segments are assembled without any bolts; only fastening with a shield jack is required. As a result, buildability can be improved and automatic assembly can be easily implemented.

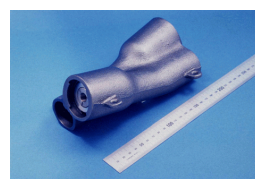
Outline of the method

The P&PCSL provides a lining ring of post-tensioned prestressed concrete structure by assembling a segmented concrete ring, giving it tension, and fastening it by inserting a prestressing single strand into the sheath that has already been embedded in the precast concrete segment.

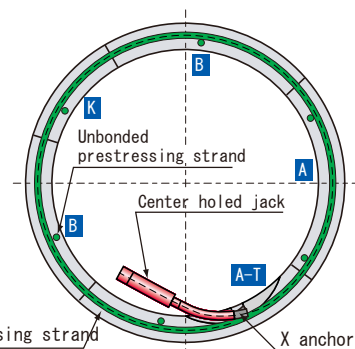
Because an unbonded prestressing strand with low friction loss between the prestressing steel and sheath is used for the prestressing strand, sufficient prestress can be introduced by applying tension to only one position on the whole circumference. Furthermore, by using a combined anchoring device made of cast iron that has the tension side and fixing side integrated into one piece (X anchor) by embedding it in the segment, the reinforcement in the segment can be simplified and buildability of tensioning can be improved.



Unbonded prestressing strand

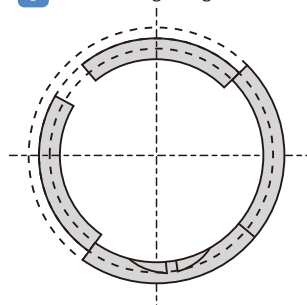


X anchor

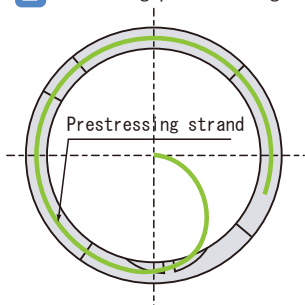


Construction Sequence

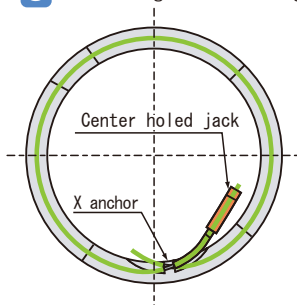
1 Assembling segments



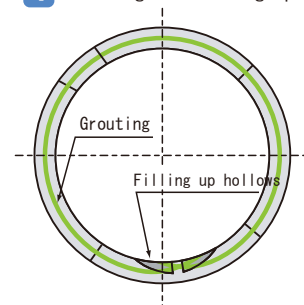
2 Inserting prestressing strand



3 Tensioning and fastening



4 Grouting and filling up hollows



Construction Experiments



▲ On'chigawa-Higashi Trunk Line of Sewage System in Lower Stream of Neyagawa Basin, Sewage Pipe Construction Work (Lining Outer Diameter: 2,950 mm)



▲ Yao-Hiraoka Trunk Line of Sewage System in Lower Stream of Neyagawa Basin, Sewage Pipe Construction Work (Lining Outer Diameter: 3,550 mm)



▲ Shitanoya Trunk Line of Yokohama City Northern Treatment District Construction Work (Lining Outer Diameter: 2,750 mm)



▲ Midorigaoka Rainwater Trunk Line of Sagami-hara City Public Drain Construction Work (Lining Outer Diameter: 3,120 mm)