Full Precasting of Large Underground Structures Using Circular Segments
— Development of Super Ring Method —

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Super Ring Method is a precast method in which segments set above ground are assembled in a circle, firmly integrated into a ring form by prestressing, hung down into an open underground space and connected underground to form a structure. This is an epoch-making precast method that addressed the challenges posed by conventional methods (cast-in-place concrete method, precast method) such as process shortening, labor reduction, improvement of cut-off performance and cost reduction through a change in the body shape from rectangular to round. Figure 1 shows the construction procedure.

Full-scale construction experiment (See photos 1 to 3)

A full-scale experiment was carried out to confirm the quality and workability of the Super Ring Method. A segment with outside diameter of 12 meters (equally divided in eight parts) was assembled and a total of four rings were made above ground, lifted, set underground, slid and integrated.
As a result, 1) segments were assembled into almost perfect circles without joint offset, 2) the stress, deformation and opening of joint were within the predicted range, 3) high cut-off performance was confirmed in cut-off experiment and 4) construction was smoothly carried out witha small number of people (7 workers).
Thus, it was confirmed that the method had no problems in quality and workability.

Photo 1 Assembly of segments above ground

Photo 2 Liftup

Photo 3 Assembly of 4 rings completed

Features of the construction method

1) The assembly of segments above ground and integration of the rings underground can be separately and simultaneously conducted. This can drastically shorten the process (to 1/2 of cast-in-place method) and reduce the number of workers.
2) Segments manufactured in factories are assembled in almost perfect circles above ground, so the body is excellent in cut-off performance with little opening and misalignment.
3) The circular structure, which is dynamically advantageous, allows for the reduction of the weight of the components to about 1/4 of that of the cast-in-place construction as well as the reduction of the amount of concrete and cost.
4) This method is suitable for urban areas with limited working space because the construction yard is fixed in one place, where rings are lifted, set underground and slid, the jack equipment is simple and no reaction walls are necessary.

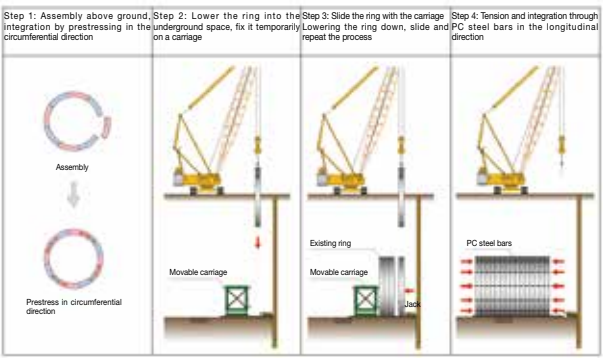

Fig.1 Construction process