

Investigation on the shield method by jack-driving

Whole term

2001.1~2003.3

(Purpose)

With the current need for the cost reduction of public utility-projects, it is considered to be important to reduce the cost of the shield and segments in shield construction. A new system for the cutter driving part of the shield that the elastic motion of fluid-pressure would jack into the rotating motion, is developed instead of the existing method consisting of a driving motor, a pinion and a gear. With this new driving system, the total cost reduction is possible through a lower shield production cost, shorter time for production/assembly/disjointing and reduced construction cost with exclusive use of machines.

The investigation on the utilization, the efficiency and the workability was performed by actual production and construction of the system for installation of the jack-driven eccentric multi-axis shield for sewage reconstruction. This research aimed at verifying the characteristics and effect of the jack-driving type applied to the eccentric multi-axis shield and publishing a technical manual on design and construction.

(Outline of the system)

The jack-driven system of this research combines the plural fluid-pressure jack at the back of the wall with a linking board and makes the linking board do the parallel link motion by elastic motion of the jack and converts it into a torque by the linking axis, producing the rotating power of the rotational axis, as shown in figure 1.

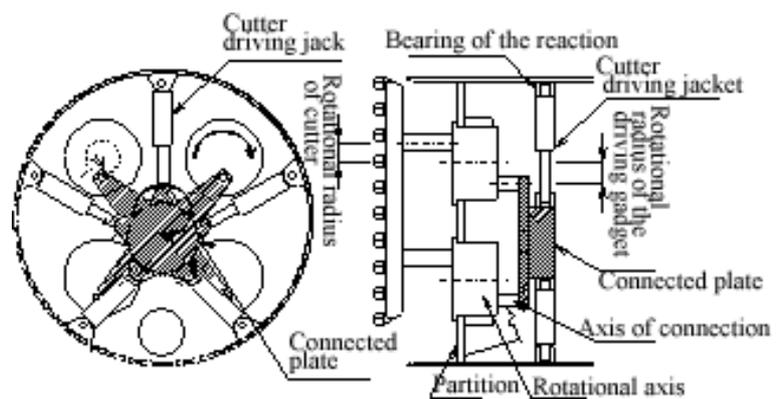


Figure 1. The schematic diagram of the jack-driven system

(Results)

1) Theoretical investigation

The theoretical basis for the experimental planning was made by the fundamental theory of jack-driving mechanisms based on the basic experiments with instruments.

2) Confirmation of the experimental design

The design and planning for experiments of the jack-driven eccentric multi-axis shield were made based on the specific conditions of small-size (about $\text{\O} 3\text{m}$), medium-size (about $\text{\O} 6\text{m}$), and large-size ($\text{\O} 12\text{m}$) ones.

3) Examination of the reaction-supporting part of the driving jack

In the jack-driven system, the copper ring located at the outer part of the shield machine supports the reaction force. For the case in which the jack driving force was large, FEM analysis was performed for strength and strain at the cutter part.

4) Verification by actual construction

The system of jack-driving type applied to the eccentric multi-axis shield was established by this research, and the utilization was verified by the stable driving performance in an actual experiment.

(Summary)

The following characteristics are possessed by the jack-driving system:

- 1) The total loss of the pinion, gear and etc. are reduced and the exclusive use is available.
- 2) The length of the machine is short without a motor.
- 3) The total construction cost is reduced by the smaller particle diameter size.
- 4) Wider open space in the wall makes it easy for injection-equipments and a manhole to be installed.
- 5) The system is simple and easy to be maintained.
- 6) When dismantling, the workability and safety can be improved by small amount of lubricant and compactness of the system.
- 7) The jack control is performed by the detection of elastic displacement so that the controlling is simple and easy.

Collaborators: Japan Institute of Wastewater Engineering Technology

Daiho Corp., Ishikawajima-Harima Heavy Industries Co., Ltd,
NKK Corp., Hitachi Construction Co., Ltd.

Personnel in charge of the study: Tsuneto Takaso, Takuro Kodama, Kozo Kamata, Syuichi Masuoka

Keywords

Shield method, Jack-driving system, Eccentric multi-axis shield